9

Education, Training, and Outreach

"Understand this is not just a job for politicians. So I'm going to need all of you to educate your classmates, your colleagues, your parents, your friends. Tell them what's at stake. Speak up at town halls, church groups, PTA meetings. Push back on misinformation. Speak up for the facts. Broaden the circle of those who are willing to stand up for our future."[1]

—President Barack Obama

In 2012, the U.S. Global Change Research Program (USGCRP) expanded its mission statement to include education as a critical component of the nation's response to global change. This new mission articulates USGCRP's role in addressing the mandated scope of the Global Change Research Act of 1990 over the next decade: "To build a knowledge base that informs human responses to climate and global change through coordinated and integrated Federal programs of research, education, communication, and decision support." The resulting USGCRP strategic plan emphasizes better integration of social, ecological, and physical sciences to understand changing conditions, increased utilization of scientific information and knowledge, and better communication and education (USGCRP 2012b).

The increased strategic focus of the federal government and its partners on climate change communication and education programs in the United States seeks to promote a deeper understanding of the science of climate change, behavioral change, and stewardship, and to support informed decision making by individuals, organizations, and institutions—all of which are summarized under the term "climate literacy."[2] The ultimate goal of climate literacy is to enable individuals, businesses, and communities to address climate change, in terms of stabilizing and reducing emissions of greenhouse gases (GHGs), and also increasing capacity to adapt to and prepare for the consequences of climate change.

U.S. educational efforts focus on three distinct, but related, areas: the science of climate change, the human–climate interaction, and using climate education to promote behavioral change. Each of these approaches is represented in the *Atlas of Science Literacy* (AAAS and NSTA 2007) and in the conceptual framework for science education developed at the National Research Council (NRC) in 2011 (Quinn et al. 2013). These approaches also informed the development of the *Next Generation Science Standards for Today's Students and Tomorrow's Workforce*—an innovative way to address climate change education within the decentralized U.S. education system (Figure 9-1) (NAS et al. 2013).

Climate change communication faces many challenges. Federal agencies, civil society, and individuals have invested in numerous initiatives to develop a climate-literate citizenry and skilled workforce. The authors of *America's Climate Choices* found that although "climate change is difficult to communicate by its very nature, … education and communication are among the most powerful tools the nation has to bring hidden hazards to public attention, understanding, and action" (NRC 2011).

[1] President Barack Obama's speech at Georgetown University announcing his new climate change policy, June 25, 2013. See http://www.georgetown.edu/landing/1242711958096.html.

[2] See http://www.climate.gov/teaching/teaching-climate-literacy-and-energy-awareness.

Figure 9-1 **University of Maryland Awarded Grant for Renewable Energy Systems**

UMD was selected as a Maryland Energy Administration Project Sunburst Initiative Partner and awarded a grant aimed at promoting the installation of renewable energy systems on public buildings in Maryland. This photo shows a part of the Severn Solar Array, which was installed in 2011 with more than 2,600 solar panels.

Photo: Frances Avendano.

Numerous federal agencies, nongovernmental organizations (NGOs), and individuals have supported sustained and robust educational and communication initiatives to harness these tools. When citizens have knowledge of the causes, likelihood, and severity of climate impacts, as well as of the range, cost, and efficacy of options to adapt to impacts, they are more prepared to effectively address the risks and opportunities of climate change. Furthermore, since 2010, more Americans than ever before have experienced the impacts of climate change first-hand in the form of extreme events, such as Superstorm Sandy and prolonged drought, resulting in increased public interest in and an opportunity for engagement on climate literacy issues.

UPDATES SINCE THE 2010 *U.S. CLIMATE ACTION REPORT*

Climate change education, training, and outreach efforts have matured significantly since the *U.S. Climate Action Report 2010* (2010 CAR) (U.S. DOS 2010), even in the recently constrained budgetary environment. Since the 2010 CAR, federal programs that support formal educational initiatives on climate change have begun to develop a coordinated national network of regionally or thematically based partnerships devoted to increasing the adoption of effective, high-quality educational programs and resources related to the science of climate change and its impacts. These programs involve kindergarten through grade 12 (K–12) and undergraduate curricula and postgraduate professional development programs, as well as informal education programs conducted in museums, parks, nature centers, zoos, and aquariums across the country.

Federal Program Coordination

Federal agencies coordinate climate change educational efforts through USGCRP and other cross-cutting initiatives. USGCRP, which coordinates and integrates climate research across 13 government agencies, included education in its 10-year strategic plan (USGCRP 2012b). USGCRP has committed its focus over the next decade not only to encouraging greater public understanding of the science through the dissemination of relevant, timely, and credible

global change information, but also to gaining further understanding of the public's science and information needs through engagement and dialogue. This two-pronged approach will help decision makers at all levels to make informed decisions. This strategy is being implemented through the integration of communication, education, and engagement into core USGCRP activities.

As the leading federal authority on global change science, USGCRP, together with its member agencies, is uniquely positioned to serve as the gateway to global change information for the nation, and has taken a leadership role in the development of the scientific workforce of the future. Many other federal agencies, such as the U.S. Environmental Protection Agency (EPA), National Park Service (NPS), National Oceanic and Atmospheric Administration (NOAA), and National Institute of Food and Agriculture (NIFA), also have the capacity to communicate with citizens on specific aspects of global change related to their respective missions. Many of these agencies have supported educational institutions in developing a pipeline of the scientific workforce relevant to global change.

While individual agency actions are important and their contributions in the aggregate are significant, one of the greatest strengths of USGCRP is its ability to develop synergies across federal agencies to coordinate efforts in communication and education. The USGCRP strategy for communication, education, and engagement efforts over the next decade will build on the strengths of the participating agencies. USGCRP will coordinate the development of multi-agency products and programs, grow and expand the reach of information beyond single agencies, and ensure that feedback from public engagement is shared broadly within the federal global change science community.

The coordination in climate change communication and education across the federal departments and programs contained in the 2010 CAR has continued through the USGCRP Communication and Education Interagency Working Group. This group develops a national climate change education communication strategy that includes all USGCRP members, and coordinates climate education, communication, and engagement activities and priorities across the USGCRP members.

For example, the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), and NOAA coordinated in the Tri-Agency Climate Change Education grant effort.[3] In another example, discussions among NSF, NOAA, NIFA, EPA, and NASA in 2009 led to the development of the NSF Climate Change Education Partnership (CCEP) Program, which develops transdisciplinary collaborations among climate scientists, learning scientists, and education practitioners working in formal and informal learning environments, discussed in more detail below.

Sample Partnerships in Climate Change Education

In fiscal year (FY) 2010, NSF launched an innovative science education program focused on educating students, teachers, and the public about global climate change and its impacts. Structured as a two-phase competition, the CCEP Program established new transdisciplinary collaborations among climate scientists, learning scientists, and education practitioners working in formal and informal learning environments. Numerous federal agencies partner with these NSF-funded projects, including NASA, NOAA, and the U.S. Department of the Interior (DOI). The following initiatives are examples of federal partnerships in climate change education.

Climate Literacy Zoo Education Network

The NSF-funded Climate Literacy Zoo Education Network (CLiZEN) highlights some of the important results of CCEP. The overarching purpose of CLiZEN was to develop and evaluate a new approach to climate change education that connects zoo visitors to polar animals currently endangered by climate change, leveraging the associative and affective pathways known to dominate the general public's decision making. CLiZEN built on interagency principal investigator meetings, and the NOAA-funded research on American attitudes about the ocean and climate change (Boyle and Mott 2009).

[3] *See* http://gcce.larc.nasa.gov/trace/trace_catalog.php and https://nice.larc.nasa.gov/tri_pi/.

Utilizing a polar theme, the network brings together a strong multidisciplinary team led by the Chicago Zoological Society, with a geographically distributed consortium of nine partners: Columbus Zoo & Aquarium, Ohio; Como Zoo & Conservatory, Minnesota; Indianapolis Zoo, Indiana; Louisville Zoological Garden, Kentucky; Oregon Zoo, Oregon; Pittsburgh Zoo & PPG Aquarium, Pennsylvania; Roger Williams Park Zoo, Rhode Island; Toledo Zoological Gardens, Ohio; and the Polar Bears International.

The project's long-term vision focuses on the development of a network of U.S. zoos, in partnership with climate change domain scientists, learning scientists, conservation psychologists, and other stakeholders, that fosters changes in public attitudes, understanding, and behavior surrounding climate change. This vision was captured in the e-book *Climate Change Education: A Primer for Zoos and Aquariums* (Grajal and Goldman 2012). Much of this work has been continued by the NSF-funded National Network for Ocean and Climate Change Interpretation.[4]

NSF, NOAA, and NASA Grant Collaboration

Since FY 2009, NSF has also participated in a multi-agency effort to coordinate U.S. government investments in climate change education through a collaboration with NOAA and NASA, which also have grant programs related to climate and environmental education. The three agencies now jointly convene annual meetings of the awardees of their respective grant programs—representing more than 120 projects—to share insights, resources, tools, and strategies. This event has provided a crucial mechanism for coordination, and has enhanced learning among practitioners of climate change education at a range of levels.

Climate Change Education Roundtable

To support and strengthen these education initiatives, and in response to a 2009 congressional mandate connected to NSF's funding for a climate change education program, NRC's Board on Science Education, in collaboration with the Committee on Human Dimensions of Global Change and the Division on Earth and Life Studies, created the Climate Change Education Roundtable.[5] The roundtable provides a forum for dialogue among practitioners and experts in multiple disciplines relevant to climate change education. It facilitates collaboration among federal agencies and private organizations, helping to promote unique contributions and align overall education strategies. Two NRC Roundtable reports provide significant input for this chapter:

- *Climate Change Education: Goals, Audiences, and Strategies: A Workshop Summary* (Forest and Feder 2013) and
- *Climate Change Education: Formal Settings, K–14: A Workshop Summary* (Beatty et al. 2013).

Table 9-1 at the end of this chapter presents an extensive listing of federal agencies' online, climate-relevant education resources.

Climate Literacy and Energy Awareness Network[6]

CLEAN is an important community-based informal network of scientists, educators, policymakers, community leaders, students, and citizens who are engaged in fostering climate and energy literacy in the United States and abroad. CLEAN provides a forum for organizations, agencies, and individuals to collaborate for climate education. Members share ideas, coordinate efforts, promote policy reform, develop learning resources, and support integration of climate literacy into formal and informal education venues. Initiatives of CLEAN feature accurate scientific information, engaging learning experiences, and multiple formal and informal pathways to reach broad and diverse audiences.

National Efforts to Engage Americans on Climate Change

Since the publication of the 2010 CAR, NGOs and federal, state, and local governments have conducted major communications campaigns to raise awareness and educate the nation about a variety of climate issues. As noted above, this chapter focuses on federal efforts, and is therefore not an exhaustive compilation of all of these actions.

[4] *See* http://support.neaq.org/site/PageNavigator/prof_devel_study_circle.html.

[5] *See* http://sites.nationalacademies.org/DBASSE/BOSE/CurrentProjects/DBASSE_072014#.UgTobfmR-So.

[6] *See* http://cleanet.org/clean/community/cln/index.html.

Connecting the Dots between Climate Change and Extreme Weather Events

The extreme weather events in the United States over the last four years have presented perhaps the most effective educational opportunities.

In 2012, the nation was struck by 11 individual weather and climate disasters with impacts of at least $1 billion. Cumulatively, these 11 events resulted in more than $110 billion in damages and 377 deaths, and directly affected major population centers and key industries and economic sectors.

The impact of these events on Americans' perceptions of climate change is described in the April 2013 report *Extreme Weather and Climate Change in the American Mind* (Leiserowitz et al. 2013). This report notes that 85 percent of Americans stated that they experienced one or more types of extreme weather in the past year. Additionally, 6 in 10 Americans (58 percent) believe global warming is affecting U.S. weather.

Superstorm Sandy provides insights into how extreme events have increased Americans' eagerness to learn more about climate change and how the U.S. government has leveraged this interest. On October 25, 2012, extratropical Hurricane Sandy struck the Mid-Atlantic states of New Jersey, New York, Connecticut, and Rhode Island. As a result, the national conversation regarding climate changed dramatically.

The nation's educators and communicators have been working with federal Web portals—e.g., NOAA's Climate.gov,[7] NASA's Climate Portal,[8] EPA's Climate Change Portal,[9] and the Climate Change Indicators in the United States site,[10] and NGOs like Climate Nexus,[11] Climate Access,[12] and Climate Central[13]—to help citizens connect the dots between climate change and extreme weather events in scientifically correct and meaningful ways. As extreme events continue to increase, these sorts of combined efforts will be needed to better serve the public's need for timely and trusted scientifically based information about how such extreme events may change in frequency or intensity in the future, and what people can to prepare for and become more resilient to their impacts.

Capitalizing on Public Survey Research

During the past four years, numerous organizations and federal programs have used public survey research on beliefs and attitudes from Yale University,[14] George Mason University,[15] and elsewhere to differentiate their climate and global change education and communication projects. As a result, these programs realize that people actively interpret information and construct their own mental models based on what they personally know, value, and feel. Using this research, the U.S. climate and global change communication and education community can be much more strategic in designing and implementing programs with limited resources.

Developing Data-Driven, User-Friendly Web Sites

To support growing public requests for meaningful and timely scientific information regarding climate and extreme weather, NOAA developed Climate.gov to provide climate data and information to help build a climate-smart nation. This user-friendly, online source of timely and authoritative scientific data and information about climate is designed to serve four segments of the public: the science-interested public, scientists and specialists, formal and informal educators, and planners and policy leaders.

Since the site's prototype launch in 2010, the Climate.gov team has engaged in direct dialogue with data users and site visitors in the public and private sectors. The Web analytics from Climate.gov show significant visit spikes after each high-impact extreme event, similar to other climate change Web sites.

In May 2013, Climate.gov was redesigned based on user feedback for each of the four main audiences. New data browse and access tools, such as the Global Climate Dashboard and the Integrated Map Application, make it easier for visitors to find and use climate data. The site's scope of contents has also expanded to serve hundreds of educational resources, decision-support tools, articles, and videos.

[7] *See* http://www.climate.gov/.

[8] *See* http://www.climate.nasa.gov/.

[9] *See* http://www.epa.gov/climatechange/.

[10] *See* http://www.epa.gov/climatechange/science/indicators/.

[11] *See* http://www.climatenexus.org/.

[12] *See* http://www.climateaccess.org.

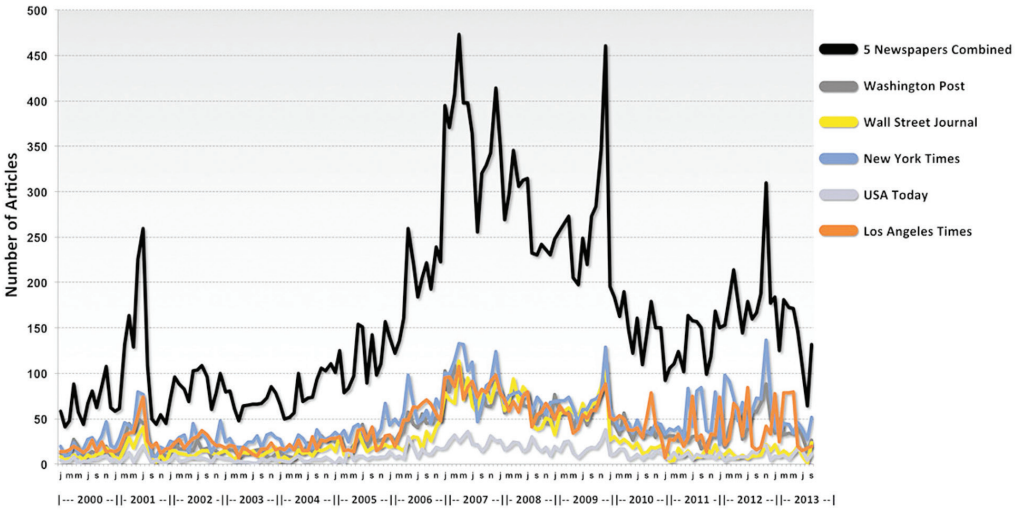
[13] *See* http://www.climateccentral.org.

[14] *See* http://environment.yale.edu/climate-communication/.

[15] *See* http://www.climatechangecommunication.org/.

Figure 9-2 **2000–2013 U.S. Newspaper Coverage of Climate Change or Global Warming**

The Center for Science and Technology Policy Research at the University of Colorado has tracked media coverage of climate change since 2000. Researchers there saw a worldwide uptick across all media in 2012 in Europe, Asia, Africa, and South America and the five largest U.S. daily newspapers.



Increasing Media Coverage

In 2009, news media coverage of climate change increased substantially (Figure 9-2). Recent studies on the role of mass media in communicating climate science, mitigation, and adaptation have been mixed or more positive. The Center for Science and Technology Policy Research[16] at the University of Colorado has tracked media coverage of climate change since 2000. Researchers there saw a worldwide uptick across all media in 2012 in Europe, Asia, Africa, and South America and the five largest U.S. daily newspapers (Fisher 2013).

Developing Next-Generation Science Standards

One of the most significant advances in K–12 climate change educational efforts is the Next-Generation Science Standards (NGSS) for teaching science in the United States (NAS et al. 2013).[17] Developed in collaboration with 26 states and several scientific organizations, these transformative guidelines for the first time recommend climate change as a core concept for U.S. science curricula, including an emphasis on anthropogenic or "human-caused" effects in both middle and high school science standards.

In the next four years, significant work in educator professional development and curricular design is planned to support this critical advancement in the nation's climate education. States across the nation have begun to adopt NGSS, which will improve overall climate literacy among all Americans, and build in the next generation a firm foundation of knowledge and discourse as the nation faces decisions on how to best deal with a changing climate.

Preparing for the Challenges and Opportunities of Climate Change

Higher education also has a key role to play in developing graduates with the skills, background, and knowledge to meet the challenges of climate change. A 2010 report by the Association for the Advancement of Sustainability in Higher Education (AASHE) calls for "ensuring that all students in higher education have access to education for sustainability and opportunities to learn how to participate in and to lead the sustainability transformation" (AASHE 2010). Over the last 20 years, scholars, activists, and others have noted that through the research they conduct, their engagement with the broader community, and the operations they oversee, colleges and universities can serve as test sites and models for sustainable practices and societies. Where colleges and universities may have the largest impact, however, is with the students they educate.

[16] See http://sciencepolicy.colorado.edu/media_coverage/us/index.html.

[17] See http://www.nextgenscience.org/.

Through the leadership of AASHE, ecoAmerica, Second Nature, and the American College & University Presidents' Climate Commitment's (ACUPCC's) 665 signatory institutions, higher education is beginning to provide college and university graduates with the skills, background, knowledge, and habits of mind that will prepare them to meet the challenges presented by climate change. ACUPCC signatories continue their ongoing efforts to publicly report on progress made to eliminate operational GHG emissions and to provide the education, research, and community engagement to enable the rest of society to do the same.

The ACUPCC Reporting System allows signatories to track, assess, and communicate progress to their campus community and beyond, demonstrating to prospective students, foundations, and potential private-sector partners that their institution is serious about its commitment to climate change and sustainability. Since the last data summary in June 2012, the number of Progress Reports on Climate Action Plans has increased from 240 to 306, providing significantly more data to draw from and demonstrating continued growth in climate and sustainability action.

To date, 68 percent of the 306 institutions that submitted a Progress Report have affirmed that their Climate Action Plan has helped them realize significant financial savings, including $119 million in savings from implemented projects. Another 137 signatories reported that they have secured funding from outside resources totaling more than $305 million to implement climate and sustainability efforts. ACUPCC signatories are building institutional capacity to foster career preparedness for their students through curriculum development, securing funding for and from climate and sustainability efforts and advancing innovation through institutional research (Figure 9-1).[18]

Audience Segmentation Strategies

The United States is using audience segmentation to prioritize strategies for communication and education about climate change, as demonstrated in the report *Climate Change Education: Goals, Audiences, and Strategies: A Workshop Summary* (Forest and Feder 2013). One of the key steps in ensuring the effective use of communication and education practices is to know the target audiences—who they are, what they already know, how they learn, and their preferred methods of communication and education.

Studies have found that different audiences have different information gaps and misconceptions and want to know different things. To this end, U.S. federal, state, and NGO programs have identified high-priority audiences, like formal educators, informal educators (e.g., weather forecasters), and decision makers. This outreach helps convey clear and concise information through appropriate communication and education channels. Following are some examples of programs using audience segmentation.

NOAA Climate.gov portal

The NOAA Climate.gov portal used an audience-focused approach to refine its design, enhance its functionality, and expand its scope of contents in response to user feedback. NOAA defines the "public" as any nongovernmental segment of society that can be characterized by its specific need for climate information and services, and its information-seeking behaviors. NOAA's Climate Literacy Objective targets six priority publics: (1) decision makers and policy leaders, (2) scientists and applications-oriented data users, (3) educators, (4) students and lifelong learners, (5) journalists and TV meteorologists, and (6) the climate-interested public.

National Wildlife Federation

The National Wildlife Federation (NWF) engages leaders in influential communities as voices for both personal and civic actions on climate and broader policy reforms (Coyle 2010). From 2007 to 2010, NWF trained 5,000 leaders in climate education from selected constituent groups. The training programs reflected lessons learned from a previous effort focused on hunters and anglers. Based on this success, NWF staff used survey research to identify and develop training aligned with the cultural sensitivities, conceptual frames, and informational needs of several other constituencies. Training was targeted to the unique interests and concerns of environmental and civic activists, master gardeners, conservative faith-based organizations, watershed conservationists, land trust leaders, birders, university groups, coastal wetland conservation organizations, and business leaders.

[18] *See* more at http://www.secondnature.org/blog/2013-04-04/second-nature-applauds-unprecedented-progress-made-signatories#sthash.SiBUHXe2.dpuf.

Interfaith Power and Light

Interfaith Power and Light (IPL), the largest faith-based climate change organization in the United States, works with more than 10,000 congregations in 38 states. The community of faith-based organizations is growing to include the National Religious Partnership for the Environment, the National Council of Churches Eco-Justice Programs, the Evangelical Environmental Network, and the Coalition on the Environment in Jewish Life. IPL has identified several key barriers to the acceptance of climate change information in faith-based audiences. State directors of IPL also reported success across audiences using messages framed in terms of certain values, including stewardship and eco-justice.

Center for Climate and Energy Solutions

The Center for Climate and Energy Solutions' (C2ES') primary mission is to engage the business community on climate change issues, by providing credible information and workable solutions and framing appropriate messages. C2ES programs have found that although climate change remains a polarizing issue in the United States, there are ways to communicate effectively about the challenges and engage government, business, and individuals in finding solutions. C2ES has found that peer-to-peer learning is very effective for climate change education.

Effective education and communication efforts directed toward the public and decision makers are interactive and ongoing. Effective programs allow for feedback of shared knowledge, provide a forum for sustained discussions of climate change impacts, and build trust between the public and policymakers. Decision makers reflect community values, needs, and interests. Recent U.S. climate education, communication, training, and engagement allow the public and policymakers to engage in a dialogue in which all viewpoints are understood and considered.

FEDERAL AGENCY EDUCATION, TRAINING, AND OUTREACH PROGRAM OVERVIEWS

A significant number of federal agencies provide state and local governments, industry, NGOs, and the public with information about national and global climate change research and risk assessments studies, U.S. mitigation activities, and policy developments. They work both independently and in partnership with other agencies, NGOs, and industry toward the common goal of increasing awareness and understanding about the potential environmental and societal challenges posed by climate change and opportunities for solutions. As President Obama said in the June 25, 2013, release of his *Climate Action Plan*: "We've got to look after our children; we have to look after our future; and we have to grow the economy and create jobs. We can do all of that as long as we don't fear the future; instead we seize it [EOP 2013a]."

U.S. Global Change Research Program

USGCRP is responsible for communicating with a variety of stakeholders nationally and globally on issues related to climate variability and climate change science, and for coordinating the federal agencies' climate change communications and education programs. The Communications and Education Interagency Working Group leads efforts to coordinate interagency education and communications activities.

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

NOAA is committed to developing a society that is environmentally responsible and uses effective, science-based problem-solving skills. NOAA recognizes that improvements in societal stewardship of natural resources extend directly from effective stakeholder engagement, training, extension, and formal and informal education systems.

NOAA's climate education programs support the development of strong and comprehensive educational materials about climate and oceanic and atmospheric sciences. NOAA works to facilitate a formal education system that produces climate-literate citizens by engaging participation from policymakers, academic institutions, professional associations, teachers, and students.

In addition, informal education plays a critical role in developing climate-literate citizens. To help equip informal education institutions with modern instructional resources and

interdisciplinary methods for teaching Earth system science, NOAA partners with aquariums, zoos, national parks, national marine sanctuaries, national estuarine research reserves, and National Sea Grant colleges (Figure 9-3). NOAA also works with other informal science education centers addressing climate change through the Climate Interpreter Network, which is funded by the Institute of Museum and Library Services, NOAA, and NSF. NOAA is engaged in improving both formal and informal education systems because these venues are important to the development of literate citizens and to the long-term maintenance of their skills, knowledge, and attitudes. Partnerships and collaboration are integral to sustaining and scaling up NOAA's ability to promote public climate literacy.

NOAA's Regional Integrated Science and Assessments (RISA) program and the National Integrated Drought Information System (NIDIS) support research teams that help expand and build the nation's capacity to prepare for and adapt to climate variability and change. Central to the RISA and NIDIS approaches are commitments to process, partnership, and trust building, with the goal of translating science into actionable knowledge and increasing capacity for making decisions in a rapidly changing environment. As societal awareness of climate risk grows, climate information is being infused into public spheres in richer ways, placing more emphasis on innovation of different methods for providing actionable knowledge. The dialogue between scientists and stakeholders also provides the perfect setting for social scientists and outreach experts to evaluate how well science is informing societal outcomes. RISA and NIDIS work closely with applied scientists who provide predictions and projections of weather and climate, with cooperative extension and outreach professionals, and with communications experts.

NOAA addresses growing societal challenges and the need for enhanced information products and services through integrated research, monitoring, and services development, including regional climate assessments, early-warning information systems, and training and education activities.

Figure 9-3 **Global Dimensions and Local Impacts of Climate Change**

Visitors to the Miami Science Museum explore the global dimensions and local impacts of climate change through a bilingual exhibit featuring Magic Planet® and interactive displays. The exhibit is funded by a NOAA Environmental Literacy Grant.

Photo: Juan Manuel Garcia Studio.

U.S. Department of Energy

Global Change Education Program

The U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE) funds partners to develop curricula and implement standardized, high-quality training programs. These projects are aimed at creating a pipeline beginning at the K–12 level and extending through the postgraduate level to ensure the ongoing development of a workforce to invent and scale up clean energy and energy efficiency technologies and processes over the long term. Education and workforce training are critical parts of EERE's mission, which is to create an energy-literate generation of skilled workers, leaders, and innovators who will produce affordable, abundant, and clean energy, thus accelerating the transition to a low-carbon economy and ensuring U.S. global competitiveness.

U.S. Department of Health and Human Services

Centers for Disease Control and Prevention and National Institute of Environmental Health Sciences

Climate change information, education, and outreach from the U.S. Department of Health and Human Services (HHS) center around impacts of climate change on human health, with a particular focus on vulnerable populations. These activities are primarily coordinated through programs at the Centers for Disease Control and Prevention (CDC) and the National Institute of Environmental Health Sciences (NIEHS). CDC's program is aimed at state and local public health departments, and NIEHS serves the education and research communities.

Both institutions, along with The National Library of Medicine, also maintain Web sites with climate change and health information links designed for use by the general public. NIEHS also serves as the HHS principal to the USGCRP and, along with CDC and NOAA, co-leads USGCRP's Climate Change and Human Health Working Group, through which many interagency communications and outreach activities are planned and implemented.

U.S. Department of the Interior

DOI has an integrated climate change research and adaptation strategy for itself and its agencies. DOI agencies include its research arm, the U.S. Geological Survey USGS), and land- and resource-managing agencies, such as the National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), Bureau of Land Management (BLM), Bureau of Reclamation (BOR), Bureau of Indian Affairs (BIA), Bureau of Ocean Energy Management (BOEM), and related agencies and offices.

DOI's climate strategy has a hub and spokes, with the hub located in the USGS National Climate Change and Wildlife Science Center, and the spokes located in the eight regional DOI climate science centers (CSCs) set up since 2010. The CSCs are operated in conjunction with universities in each region of the United States. In addition to advising land managers about research related to their regions, the CSCs coordinate with 22 landscape conservation cooperatives (LCCs) composed of landowners near U.S. parks, refuges, and other lands; government officials at the federal, state, and local levels; tribal leaders; and nonprofit and citizens' groups.

DOI, its bureaus, and CSCs and LCCs maintain climate Web pages and sites, as well as create social media, press releases, and publications related to climate change. In addition, parks and refuges have public education programs.

National Park Service

The NPS manages 3.4 million hectares (ha) (84 million acres [ac]) of land, including more than 400 national parks and other units; almost a million historic structures and archeological sites; thousands of kilometers of rivers; and 69,463 kilometers (43,162 miles) of shoreline. Because some of America's greatest wildlands, wildlife, and cultural treasures are especially vulnerable to climate change, the NPS considers it one of the agency's greatest challenges.

The NPS *Climate Change Action Plan: 2012–2014* builds on a strategy released in 2010, stating that by articulating "a set of high-priority, no-regrets actions the NPS is currently undertaking or committed to undertake, in the next one to two years" to help park managers and staff effectively plan for and respond to climate change (U.S. DOI/NPS 2010). Near-term priorities include enhancing workforce climate literacy; engaging youths and their families in climate

change research, education, and hands-on projects; providing climate change science in parks; implementing a *Green Parks Plan* (U.S. DOI/NPS 2012); applying appropriate adaptation tools and options; and strengthening communication with the public within the "natural classrooms" in the parks and through a wide variety of interpretive and educational media.

Between 2007 and 2012, NPS held 17 workshops to train park managers on scenario planning. In addition, NPS's Climate Change Response Program has provided climate change-related training to NPS staff since 2007. Over the longer term, NPS planning is flexible to adapt to ongoing and emerging developments, such as climate change research, new advances in media and technology, and extreme events and disasters.

U.S. Fish and Wildlife Service

FWS administers the U.S. wildlife conservation laws, monitors and manages migratory birds, restores nationally significant fisheries, conserves wetlands, and regulates international wildlife trade. FWS also manages the 4-million-ha (96-million-ac) National Wildlife Refuge System. All of these responsibilities require preparation for climate change and adaptation, contained in the FWS climate strategy.

In addition, FWS has taken the lead in setting up the interagency LCCs that work in conjunction with the CSCs. These cooperatives address the challenges that are too great for any single national wildlife refuge, national park, or other community to manage alone—such as drought, climate change, and large-scale habitat fragmentation. The 22 LCCs work together on mutual conservation goals, benefitting from scientific and technical expertise beyond the reach of any one group.

FWS also co-led the development of the March 2013 *National Fish, Wildlife and Plants Climate Adaptation Strategy* (U.S. DOI/FWS 2012). This is the first nationwide strategy to help public and private decision makers address the impacts that climate change is having on wildlife and other natural resources and the people and economies that depend on them. The strategy's development was guided by an innovative partnership of federal, state, and tribal fish and wildlife conservation agencies in response to a 2010 call by the U.S. Congress for a national, government-wide climate adaptation strategy to assist fish, wildlife, and plants, and related ecological processes in becoming more resilient to, adapting to, and surviving the impacts of climate change.

The partnership was co-led by FWS, NOAA, and the New York State Department of Environmental Conservation (representing state fish and wildlife agencies). An intergovernmental steering committee that included representatives from 15 federal agencies, five state fish and wildlife agencies, and two inter-tribal commissions oversaw development of the strategy, with extensive public input and support from the Association of Fish and Wildlife Agencies.

U.S. Geological Survey

USGS is a multidisciplinary science arm of the U.S. government that undertakes scientific research, monitoring, remote sensing, modeling, synthesis, and forecasting to address the effects of climate and land-use change on the nation's resources. The resulting research and products are provided as the scientific foundation upon which policymakers, natural resource managers, and the public make informed decisions.

USGS runs the National Climate Change and Wildlife Science Center, which provides scientific and technical support to other agencies on the impacts of climate change. USGS also helped DOI establish the CSCs.

The USGS Land Remote Sensing Program operates the Landsat satellites (which are built and launched by NASA) and provides the nation's portal to the largest archive of remotely sensed land data in the world. These images serve many purposes, including tracking climate change. In addition, the Earth Resources Observation and Science Center contributes to USGS's climate and land-use programs with basic and applied research, data acquisition, systems engineering, and information access and management. USGS also conducts research to assess the potential capacities and limitations of various forms of carbon sequestration.

Bureau of Land Management

BLM manages more than 9.9 million ha (245 million ac) of public land for a wide variety of uses, including conservation, energy development, and recreation. Most of this land is found in the West, where average temperatures are rising, droughts are increasing, snowpack is declining, water supplies are diminishing in key areas, and wildfires have become larger and more frequent. BLM is undertaking two connected initiatives to understand, anticipate, and respond to the effects of climate change on the public lands: Rapid Ecoregional Assessments, which are currently being prepared, and a landscape approach for managing public lands.

Bureau of Reclamation

BOR conducts research on the effects of climate change on water supplies that is useful to water managers and decision makers. The WaterSMART program provides grants and other resources to help communities improve climate analysis tools and stretch water supplies through various conservation and water recycling projects. The WaterSMART Clearinghouse provides water resource planners and managers with tools related to water conservation and sustainability, arranged by term, topic, state, river basin, or tribal area.

U.S. Department of Transportation

DOT has developed many programs to educate the public, government employees, state and local agencies, and other transportation stakeholders about climate change.

Federal Transit Administration

FTA has several programs that provide information about the benefits of public transit and how to reduce the environmental impacts of transportation. The Environmental Management Systems Training, in particular, offers training for public transit agencies to assess and reduce the environmental impacts of their operations, including their carbon footprint.

FTA organizes, sponsors, and participates in numerous conferences as part of its outreach efforts, including conferences and sessions geared toward education on environmental and climate change issues. During 2013, FTA sponsored and participated in climate change panels at the annual Transportation Research Board conference, the Rail-volution conference, the American Public Transportation Association sustainability workshop, and the New Partners for Smart Growth Conference.

Funded by FTA, the National Transit Institute (NTI) at Rutgers, The State University of New Jersey, was established under the Intermodal Surface Transportation Efficiency Act of 1991 to provide training, education, and clearinghouse services in support of U.S. public transportation and quality of life. NTI courses on transportation planning, environmental review, transit-oriented development, and transportation and land use are particularly relevant to climate change issues.

FTA's climate change adaptation initiative Web page provides the public and transit agencies with information on FTA efforts with regard to climate change adaptation; published reports, policy statements, and letters; past events and workshops focusing on transit adaptation to climate change; and current activities taking place (including information on the seven FTA climate adaptation pilot projects).

Federal Highway Administration

FHWA targets metropolitan planning organizations (MPOs) and local transportation agencies to provide information on their climate science and mitigation strategies. Recently, FHWA unveiled the Energy and Emissions Reduction Policy Analysis Tool (EERPAT). FHWA developed EERPAT for use by state departments of transportation (DOTs) to model a large number of inputs and policy scenarios to support strategic transportation and visioning, including GHG emission reduction alternatives. EERPAT can be used to assist state DOTs in analyzing GHG reduction scenarios and alternatives for use in the transportation planning process, climate action plans, scenario planning exercises, and meeting state GHG reduction targets and goals. FHWA has also developed a mitigation reference sourcebook to accompany the tool, which is currently being revised to highlight the GHG reduction strategies that can be analyzed by the tool (Kalra et al. 2012).

More recently, in September 2013, FHWA hosted two peer exchanges for information sharing among 19 climate resilience pilots at state DOTs and MPOs. Previously, between June 2011 and April 2012, FHWA convened three peer exchanges for transportation agencies to share information related to climate change mitigation activities. These efforts are in addition to a DOT-wide effort to educate federal and state employees about a variety of transportation and climate change issues. For example, the Transportation and Climate Change Clearinghouse Web site, a one-stop source of information on transportation and climate change issues, includes information on GHG inventories, analytic methods and tools, GHG reduction strategies, potential impacts of climate change on transportation infrastructure, and approaches for integrating climate change considerations into transportation decision making.

National Aeronautics and Space Administration

NASA supports extensive education, training, and public awareness on climate change that take advantage of NASA's capabilities of observing the Earth system from space. In addition to programs targeted at training at the graduate and early-career levels, NASA is committed to building partnerships in communication and education to effectively reach various segments of the public.

The Global Learning and Observations to Benefit the Environment (GLOBE) program, jointly sponsored by NASA and NSF, continues to support teachers and students to conduct hands-on research projects about their local environment across 109 countries worldwide.[19] The NASA Innovations in Climate Education project offers opportunities to educational institutions in climate education.[20] Through Earth to Sky, NASA also works with interpretation experts at NPS, FWS, BLM, and other agencies to connect the wonder of science with the power of place by providing relevant and integrative information about climate change to the public.[21] Finally, NASA participates in public events and engages the public online, to promote broader understanding of climate change and its impacts on society.[22]

National Science Foundation

Consistent with its mission to support research and education across a broad range of science and engineering disciplines, NSF funds research in numerous areas related to global climate change. NSF's Directorates for Geosciences; Biological Sciences; Social, Behavioral, and Economic Sciences; Education and Human Resources; Mathematics and Physical Sciences; Computer and Information Science and Engineering; and the former Office of Polar Programs (recently merged with Geosciences) participate in the USGCRP and provide access to climate-related results from principal investigators.

NSF is the principal federal agency charged with promoting science, technology, engineering, and math education. To this end, NSF supports the development of a diverse and well-prepared scientific and technical workforce, and a scientifically literate citizenry.

Smithsonian Institution

The Smithsonian is addressing the global challenge of climate change with special exhibitions and ongoing research. Smithsonian collections related to the evidence about the impacts of and responses to climate change provide a unique and accessible resource for public education. Smithsonian scientists and curators regularly engage the museums' visitors with evidence about climate change issues, from the perspectives of science, history, and art.

U.S. Agency for International Development

As a the foreign assistance arm of the U.S. government, USAID plays a leadership role in delivering climate change-related international assistance to more than 40 developing and transition countries. With headquarters in Washington, D.C., USAID has field offices in many regions of the world—namely, sub-Saharan Africa, Asia, the Middle East, Latin America and the Caribbean, and Europe and Eurasia. USAID works in close partnership with private voluntary organizations, indigenous groups, universities, American businesses, international organizations, other governments, trade and professional associations, faith-based organizations, and other U.S. government agencies.

[19] *See* http://www.globe.gov.

[20] *See* http://gcce.larc.nasa.gov/.

[21] *See* http://earthtosky.org/.

[22] *See, for example,* http://climate.nasa.gov, http://earthobservatory.nasa.gov, social media.

USAID's foreign assistance work incorporates climate change considerations into development projects, supporting on-the-ground programs to achieve climate change results and strengthen economic growth. Climate change education, training, and outreach are a cornerstone of USAID's activities, providing the foundation for sustainable actions (Figure 9-4). Capacity building for improved decision making through applied science and access to information is increasingly important. (This work is highlighted in Chapter 7.) Building on clean energy, sustainable landscapes, and adaptation strategies, USAID will continue to integrate education, outreach, and training into its development mission to contribute to reducing the threat of climate change around the world.

U.S. Department of Agriculture

Agricultural Research Service

As USDA's chief intramural scientific research body, ARS is responsible for research on the impacts of agricultural practices on potential climate change or disruptions and vice versa. Although ARS has no formal educational mechanism to disseminate research information to the general public, it employs a number of less formal means to communicate and make use of research advances. All USDA scientific research publications are submitted with an Interpretive Summary that is used for timely news releases. In addition, through collaboration with university scientists, climate change research information is provided to state and county cooperative extension agencies for release to identified producers. Also, all USDA field locations publish informative brochures and technical reports that describe their work and the impacts of the research findings on stakeholders' interests.

National Institute of Food and Agriculture

Established by the Food, Conservation, and Energy Act of 2008, NIFA replaced the former Cooperative State Research, Education, and Extension Service, which had been in existence since 1994. NIFA is the primary USDA agency that supports extramural research, extension, and education activities by providing competitive and capacity funds in such areas as agriculture and natural resources science for climate variability and change. The NIFA Coordinated

Figure 9-4 **The Role of Mangrove Ecosystems in Building Resilience to the Effects of Climate Change**

During a field trip and workshop for Utwe elementary school teachers in Kosrae in the Federated States of Micronesia, participants learned about the connections between water salinity and the resilience of mangrove ecosystems to climate change, and role of mangroves in protecting island coasts from sea level rise and storm surges.

Photo: Julian Sachs.

Agricultural Project awards support projects to deliver the best tools available to accurately measure and respond to the effects of climate, and better understand how to work with and educate farmers, landowners, and foresters about regional climate change issues. Through federal funding and leadership for research, education, and extension programs, NIFA focuses on investing in science and solving critical issues affecting people's daily lives and the nation's future.

Climate Change Research Centers

Similar to DOI's and NOAA's regional climate centers strategy, the new USDA climate change research centers have a stated mission to educate the public about regional climate change issues.

U.S. Forest Service

USFS national efforts in climate change education, training, and public awareness are based on the scientific expertise and findings of the agency's more than 500 scientists. The USFS Research and Development program conducts research investigating how climate change is and may be affecting terrestrial and freshwater natural resources and ecosystems. These results are made available to professional resource managers and the public through a variety of Web sites and publications.

USFS also provides climate change education resources to educators and students through a variety of programs. One of these is *The Natural Inquirer*, a science education journal based on published USFS science, targeted for U.S. and international middle school students. Climate change editions of *The Natural Inquirer* have focused on contemporary research findings regarding climate change and wildfires and the impact of a changing climate on wildlife and stream temperatures.

In its most recent project, USFS has partnered with 18 other agencies and organizations to offer ClimateChangeLIVE,[23] a distance learning adventure. This project brings climate learning through a series of science-based, televised webcasts, webinars, and online climate education resources. In addition, EUGENE (Ecological Understanding as a Guideline for Evaluation of Nonformal Education)[24]—a broadly applicable, user-friendly Web-based environmental education evaluation instrument that assesses student knowledge on limits, regulation, and adaptation related to climate change—will assist educators in evaluating and improving their climate change programs and will increase accountability in climate change education.

U.S. Environmental Protection Agency

Climate change information, education, and outreach are an important part of EPA's work. EPA maintains a Climate Change Web site and a Student's Guide to Climate Change Web site, and has produced educational and informational materials that reach a wide range of audiences. In addition, EPA provides outreach programs that educate decision makers and the public about opportunities to reduce GHG emissions and adapt to the impacts of climate change that humans and nature are already facing.

EPA also runs a grant program that distributes more than $3 million a year to formal and informal education programs across the country that educate learners of all ages about the causes of and solutions to environmental problems. For the last several years, a significant percentage of those funds went specifically to climate change education programs.

[23] *See* http://www.climatechangelive.org/.

[24] *See* https://projecteugene.org/cgi-bin/eugene.

Table 9-1 **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
K–12 Students and Teachers				
National Aeronautics and Space Administration (NASA)				
Global Climate Change Education/Earth Science Education Alliance (ESSEA)	Implemented by the Institute for Global Environmental Strategies to improve the quality of geoscience instruction for pre-service and in-service K–12 teachers, ESSEA is based on a series of online courses for teachers offered by several participating universities. The inquiry-based courses provide teachers with the content knowledge and tools they need to incorporate Earth system science into their curricula. ESSEA modules are also available online as teacher resources. Many of the course modules use NASA data and content. Some examples of ESSEA course modules include black carbon, Brazilian deforestation, coral reefs, Hurricane Katrina, stratospheric ozone, and sea ice. Partners: NSF	K–12 teachers, pre-service teachers	Formal	http://esseacourses.strategies.org/
Global Learning and Observations to Benefit the Environment (GLOBE)	GLOBE is a worldwide hands-on, primary and secondary school-based science and education program. GLOBE observations and measurements include atmosphere and climate, hydrology, land cover and phenology, and soils. GLOBE students, teachers, and scientists collaborate on inquiry-based investigations of the environment and the Earth system, working in close partnership with NASA and NSF Earth System Science Projects, on research topics related to the carbon cycle, watersheds, seasons, and biomes and extreme environments. Understanding Earth as an interconnected system is at the core of the GLOBE program. Partners: NASA, NSF	K–12 students, K–12 teachers	Formal/ informal	http://www.globe.gov/
Students' Cloud Observations On-Line (S'COOL)	S'COOL is a component of NASA's CERES (Clouds and the Earth's Radiant Energy System). The CERES instrument measures the amount of energy reflected and emitted by the Earth system, focusing on understanding how clouds affect these energy transfers. Participating students make basic weather observations and record the types and features of clouds in the sky at the time the satellite passes over their location, and submit the data to NASA for entry into an online database. Students can access their results as well as those from other participating schools via the S'COOL Web site, which is available in seven languages. Satellite observations for matching times are also posted, so that students can compare their observations with those of the satellite, and scientists can evaluate CERES' performance. Participants receive instructional materials and information necessary for reporting results.	K–12 students, K–12 teachers	Formal/ informal	http://science-edu.larc.nasa.gov/SCOOL/index.php
National Oceanic and Atmospheric Administration (NOAA)				
American Meteorological Society (AMS) Education Program	This program promotes the teaching of atmospheric, oceanographic, and hydrologic sciences through pre-college teacher training and instructional resource material development. It also promotes instructional innovation at the introductory college course level; hence, the K–13 designation for the program. All programs promote activity directed toward greater human resource diversity in the sciences AMS represents. To date, more than 100,000 teachers have received training and instructional resources, which have benefited millions of students. Partners: NSF, NASA	K–12 teachers	Formal	http://www.ametsoc.org/amsedu/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Climate Stewards Education Project	This project increases understanding of essential climate concepts, providing educators with ready access to reliable scientific information through an array of professional development opportunities. Through direct interaction with scientists and education specialists, participants receive instruction in the use of data resources, digital tools, and other innovative technologies. Educators benefit from an active online learning community that offers collaborative space, Web seminars, conference symposia, workshops, and virtual conferences. Armed with this knowledge, NOAA Climate Stewards design and implement environmentally friendly action plans to reduce their communities' carbon footprint.	K–12 teachers, informal educators	Formal/ informal	http://oceanservice.noaa.gov/education/climate-stewards/
Communications and Education Program	This program takes an audience-focused approach to promoting climate science literacy among priority publics, including educators. It communicates the challenges, processes, and results of NOAA-supported climate science through stories and data visualizations on the Web and in popular media, and provides information to a range of audiences to enhance society's ability to plan for and respond to climate variability and change. Partner: USGCRP	K–12 teachers, undergraduate students, graduate students, public, professionals	Formal	http://climate.noaa.gov/education/
National Science Teachers Association's (NSTA's) The Learning Center, E-professional development portal	NSTA collaborates with NOAA, NASA, and NSF on the Learning Center to provide a variety of climate-focused online learning experiences to fit any teacher's learning style and content need. Teachers can access the center 24/7. NSTA is committed to providing the very best online professional development to science teachers. Partners: NSF, NASA, USDA/USFS, EPA	K–12 teachers	Formal/ informal	http://learningcenter.nsta.org/
National Science Foundation (NSF)				
Discovery Research K–12 (DR K–12)	DR K–12 seeks to enable significant advances in pre-K–12 student and teacher learning of the STEM disciplines through projects that study the development, testing, deployment, effectiveness, and/or scale-up of innovative resources, models, and technologies for use by students, teachers, and policymakers.	K–12 students, K–12 teachers	Formal (K–12)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=500047
Smithsonian Institution				
Climate Change Distance Learning	The National Zoological Park (NZP) is collaborating with the U.S. Forest Service (USFS), Prince William Network, NOAA, and many other groups that are working on climate change distance-learning experiences during 2014. The objectives of this effort are to (1) provide credible, science-based climate change education resources; (2) educate students about climate change; (3) share success stories about what students, schools, and communities are doing to help protect and conserve natural resources and to encourage viewers to take action; and (4) share information about what partner agencies are doing to address climate change. The plans include (1) distance-learning broadcasts and webcasts, (2) resource Web sites, (3) webinars for teachers, and (4) educational resources. The culminating student-driven event of ClimateChangeLIVE™ is planned for early March 2014. Partners: USFS, NOAA, USFWS, SI, EPA, NIST, NSF, DOE	K–12 students, K–12 teachers	Formal	http://www.climatechangelive.org/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
David H. Koch Hall of Human Origins	Based on decades of cutting-edge research by Smithsonian scientists, the David H. Koch Hall of Human Origins exhibition is the result of an international collaboration with more than 60 research and educational organizations and more than 100 researchers from around the world. Visitors are taken on an immersive, interactive journey through six million years of scientific evidence of human origins and the stories of survival and extinction in humanity's family tree during times of dramatic climate instability. Visitors can explore actual archaeological field sites at interactive snapshots in time, examine more than 75 cast reproductions of real skulls from around the world, engage with an interactive family tree of evolutionary evidence, and address pressing questions and issues surrounding climate change and humans' impact on Earth in the "One Species Living Worldwide" theatre and the "Changing the World" gallery. Educational resources, public programs, and an immersive online experience accompany the exhibit.	K–12 students, K–12 teachers, public	Informal	http://humanorigins.si.edu/exhibit
Demography of Songbird Populations in a Rapidly Changing World: The Importance of Long-Term Studies	The Migratory Bird Center staff published a paper in *American Biology Teacher* in 2011 describing a Web-based teaching module based on a long-term study of a migratory songbird, the black-throated blue warbler. The module describes this species and the ecological factors that affect its population growth and provides exercises developed to span a range of student levels. It discusses the results of the study in the context of climate change, and prompts students to consider the impact of climate change on the study population.	K–12 students, K–12 teachers	Formal	http://www.jstor.org/discover/10.1525/abt.2011.73.5.8?uid=3739256&uid=2&uid=4&sid=211028 69689333
Ecosystems on the Edge	This is a 16-part mini-video series on threats to coastal ecosystems, many of which deal with climate change. The Smithsonian Environmental Research Center is building a Web site to host the video series, which will include a section specifically devoted to climate change and how it will affect the plants, animals, and people living on the coast. A curriculum to facilitate the use of the videos by high school teachers in the classroom is also under development.	K–12 students, K–12 teachers, public	Formal, informal	http://ecosystems.serc.si.edu/
Forces of Change Program	Nearly every scientific and social issue today involves change: climate change, ecological change, cultural change, etc. What forces drive these changes? What are the tempo and mode of these changes? Are these changes natural or the result of human tampering? Are they to be feared or welcomed? How do we—and all life on this planet—adapt to these changes? This program seeks to address these questions through a variety of resources, including online exhibits and educational products.	K–12 students, K–12 teachers, public	Informal	http://forces.si.edu/index.html
Gabon Biodiversity Program	As part of ongoing conservation education efforts in Gabon, Africa, the Smithsonian Conservation Biology Institute (SCBI) conducted a climate change program in 2011 for high school students in Gamba. This topic will continue to be an important component of the education and outreach programs offered through the SCBI program, based in Gabon.	K–12 students	Formal	http://nationalzoo.si.edu/SCBI/Collaborative-Research-Initiatives/Gabon-Biodiversity-Program.cfm

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
The Habitable Planet: A Systems Approach to Environmental Science	This multimedia course for high school teachers and adult learners interested in studying environmental science was developed by the Smithsonian Center for Astrophysics (and is currently hosted by Annenberg Learner). It includes a unit on Earth's changing climate, which examines the science behind global climate change and explores its potential impacts on natural ecosystems and human societies.	K–12 teachers, public	Formal	http://www.learner.org/courses/envsci/
Looking at Earth Exhibition Gallery	Understanding Earth's environment and how climate conditions are changing with time requires the collection of weather data from all over the globe. The National Air and Space Museum (NASM) is home to a variety of historical and modern examples of the satellites, cameras, and other hardware used to examine Earth from above. NASM's Looking at Earth exhibition gallery showcases the use of the tools and tactics that have been developed over time for scrutinizing the surface of Earth from the highest of "high-ground" perspectives then attainable.	K–12 students, K–12 teachers, public	Informal	http://airandspace.si.edu/exhibitions/gal110/index.cfm
Marine Environmental Education Program	The Smithsonian Topical Research Institute (STRI) has environmental education programs that address issues of climate change. These take place at the Culebra Point Marine Exhibition Center, the Bocas del Toro Marine Laboratory, and the Galeta Point Marine Laboratory, whose marine environmental education program links STRI's research to Panama's classrooms. This program has reached 95,000 students from Panama and abroad.	Graduate students	Informal	http://www.stri.si.edu/english/education_fellowships/field_courses/index.php
Ocean Portal	The Ocean Portal is part of the Smithsonian's Ocean Initiative. Together with the National Museum of Natural History's (NMNH's) Sant Ocean Hall and the Sant Marine Science Chair, the Ocean Portal supports the Smithsonian's mission to increase the public's understanding and stewardship of the ocean. This portal includes a variety of resources related to climate change. Partner: NOAA	K–12 students, K–12 teachers, public	Informal	http://ocean.si.edu/
Punta Culebra Nature Center (PCNC)	This nonprofit initiative of STRI offers visitors an open-air museum focusing mainly on marine science and education and on conservation and interpretation of marine coastal environments. More than 700,000 students and visitors have come to PCNC since it opened in 1996, and hundreds of schools have taken part in its educational programs. PCNC addresses climate change through teacher workshops, lesson plans for students who visit the center, and summer camps. Specific topics addressed include ocean acidification, studies on carbon dioxide (CO_2) storage in tropical rainforests, changes in ocean level, and the greenhouse effect. An educational activity titled "The CO_2 Eaters," which has been included in several educational programs conducted by PCNC, was also published in the educational teacher package "Native Trees of Panama and Neotrópico" in collaboration with BioMuseo, Aprendo, and *La Prensa*.	K–12 students, K–12 teachers, public	Informal	http://www.stri.si.edu/english/visit_us/culebra/
Sant Ocean Hall	The Sant Ocean Hall is NMNH's largest exhibit, providing visitors with a unique and breathtaking introduction to the majesty of the ocean. The hall's combination of over 675 marine specimens and models, high-definition video, and the newest technology allows visitors to explore the ocean's past, present, and future. The exhibit addresses climate change through graphics and interactive features. Partner: NOAA	K–12 students, K–12 teachers, public	Informal	http://www.mnh.si.edu/exhibits/ocean_hall/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Science on a Sphere® (SOS)	NMNH and NZP participate in SOS, which is a room-sized, global display system that uses computers and video projectors to display planetary data onto a 6-foot-diameter sphere, analogous to a giant animated globe. Researchers at NOAA developed SOS as an educational tool to help illustrate Earth system science to people of all ages. Animated images of atmospheric storms, climate change, and ocean temperature can be shown on the sphere, which is used to explain what are sometimes complex environmental processes, in a way that is simultaneously intuitive and captivating. Partner: NOAA	K–12 students, K–12 teachers, public	Informal	http://sos.noaa.gov
Smithsonian Science Education Academy for Teachers on Earth's History & Global Change	This week-long summer academy is for Earth science school teachers from grades 6 through 12 and interested educators from museums and science centers. It examines global climate change from the perspective of the history of Earth from its formation through the origin of life. Topics include planetary processes, volcanism and plate tectonics, and the oceans and atmosphere. Each day participants engage Earth scientists at the Smithsonian and elsewhere in hands-on content sessions that take them behind the scenes and explore current research on Earth's past environments. Participants learn about resources available for teachers at the Smithsonian's museums and facilities and federal science agencies. Participants also have the opportunity to earn graduate credit through Virginia Commonwealth University. Partners: NASA, NOAA	K–12 teachers	Formal/ informal	http://www.scienceteachersacademies.si.edu/
Smithsonian Treebanding Project	This project recruited schools from across the world to measure how fast local trees were growing, partly to track how trees respond to climate change. Students and teachers received a kit and instructions in the mail. Later they added their data to an online database and could compare what they found with what classrooms in other countries found. At its peak, the program had 490 schools in 38 countries participating.	K–12 students, K–12 teachers	Formal	https://treebanding.si.edu/
Teacher Training Program	STRI conducts a teacher training program in coordination with Panama's Ministry of Education (MEDUCA) and with funding from the International Community Foundation. In 2013, Galeta Point Laboratory conducted its VI Teacher Training Course on Tropical Marine and Coastal Ecosystems. Altogether, 42 docents from all provinces and comarcas participated, from public and private schools. The MEDUCA participants include the national director for elementary education, the national director for science education, and the science supervisors from seven of Panama's nine provinces. During this two-week intensive course, docents receive the latest scientific material in Spanish and presentations by STRI researchers, complemented by hands-on field trips. A theme of several of those presentations was climate change and its implications for the nations of Central America and the Caribbean. Partners: Panama's Ministry of Education, International Community Foundation	K–12 teachers	Formal	http://stri.si.edu/english/about_stri/headline_news/news/article.php?id=1660

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Understanding Weather and Climate	This instructional unit for middle school students explores the atmospheric events and oceanic processes that affect Earth and its inhabitants. Students experiment with factors that determine storms and daily weather, explore the impact of the oceans on Earth, and examine the influences that produce climate zones and changes. Throughout the unit, students make predictions, collect data to test hypotheses, and draw conclusions based on evidence. This unit is part of the Smithsonian Science Education Center's Science and Technology Concepts Program, a research-based science curriculum for grades K–8.	K–12 students, K–12 teachers	Formal	http://www.carolinacurriculum.com/stc/Secondary/Weather+Climate/index.asp
U.S. Department of Agriculture (USDA)				
Chugach National Forest Children's Forest	In the summer of 2008, the Chugach National Forest was designated as a Children's Forest. One of the key programs for the Children's Forest will be a climate change research program in which students will shadow researchers from the U.S. Forest Service (USFS) and the University of Alaska. The researchers are conducting quantifiable, inquiry-based research to monitor the impacts of climate change on Alaska's forest and wetland ecosystems.	K–12 students	Formal/informal	http://www.alaskageographic.org/static/1040/programs
Forest Service Climate Change Educator Web Site	USFS has several inter-related programs to help forests, grasslands, and humans mitigate and adapt to global climate change. This site contains a variety of resources for researchers, managers, educators, and the public on climate change issues and science, and provides links to cost-free climate change education resources.	K–12 teachers, K–12 students, public	Formal/informal	http://www.fs.fed.us/climatechange/
GreenSchools! Initiative	In partnership with the American Forest Foundation, USFS selected five schools in Washington, D.C., to pilot the GreenSchools! Initiative. This program provides training and funding for diverse and underserved pre-K–12 public schools. Students and teachers investigate environmental issues at their schools and engage with their communities in ongoing service-learning projects that create green and healthy learning environments. Partner: American Forest Foundation—Project Learning Tree	Pre-K–12 teachers, K–12 students, public	Formal/informal	http://www.plt.org/cms/pages/21_23_242.html
The Investigator	Based on published USFS science, this science education journal is intended for upper elementary students in the U.S. and abroad. All resources are correlated to National Science Education Standards. Teachers can use *The Investigator* to introduce students to the concept that rising levels of ozone will affect tree growth.	K–12 students	Formal	http://www.scienceinvestigator.org
The Mayor's Green Summer Job Corps Program	USFS is joining Anacostia Urban Tree House partners to train the on-the-ground supervisors of this Washington, D.C., program, which introduces local youths to green-collar career paths. The program uses a combination of substantive work projects and traditional educational sessions to increase job readiness, connect youths to the environment within their communities, and improve the District's environment overall. Broadly, this program complements the District's efforts in combating climate change, restoring its waterways, and increasing its green infrastructure. Partner: Anacostia Urban Tree House	K–12 teachers, K–12 students, public	Formal/informal	http://green.dc.gov/green/cwpview,a,1233,q,461478.asp
The Natural Inquirer	This science education journal, based on published USFS science, is for middle school students both in the U.S. and abroad. Resources are correlated to national science education standards and are available in English and Spanish.	K–12 students	Formal	http://www.naturalinquirer.org

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
U.S. Department of Energy (DOE)				
America's Home Energy Education Challenge	DOE and the National Science Teachers Association host a competition for grades 3–8 through their schools or informal education to learn about energy and apply energy-efficient behavior changes at home.	K–12 teachers and students	Online Web site for competition, including energy curricula	www.Aheec.org
Climate Literacy and Energy Awareness Network (CLEAN)	The Teaching Climate section of climate.gov partnered with CLEAN to use the *Climate Literacy* guide to identify and integrate effective resources across different educational levels. The CLEAN framework for vetting, reviewing, and ensuring the scientific quality of climate and global change education materials on climate, energy, and related topics will be very useful to teachers and educational systems across the nation. Partners: NSF, DOE	K–12 teachers, informal educators	Formal/ informal	http://www.climate.gov/teaching
K–12 Clean Energy Activities and Curricula	One-stop shop for K–12 lesson plans, curricula, and activities.	K–12 teachers and students	Online Web site and app	http://www1.eere.energy.gov/education/lessonplans/default.aspx
U.S. Environmental Protection Agency (EPA)				
EPA Student's Guide to Climate Change Web Site	This popular environmental education site provides a wealth of resources for students and educators. Graphically engaging and interactive, this site includes information about climate change science, interactive "Climate Expeditions" to learn about climate change impacts around the globe, a section on what people can do to make a difference, resources for educators and administrators, and more. One feature is a GHG calculator, which instructs students about steps they can take to reduce their carbon footprint and what those reductions can mean for the environment. Revamped in 2011, the site has more than 30,000 unique visitors each month.	Students grades 6–8	Formal	www.epa.gov/climatechange/kids
Undergraduate Students				
National Oceanic and Atmospheric Administration (NOAA)				
Significant Opportunities in Atmospheric Research in Science (SOARS) (UCAR)	SOARS is an undergraduate-to-graduate bridge program designed to broaden participation in the atmospheric and related sciences. The program is equal parts research internship, learning community, and mentoring. Partner: NSF	Undergraduate students	Formal	http://www.soars.ucar.edu/
National Science Foundation (NSF)				
Applied Conservation Strategies and Ecology for Effective Conservation Practices	The Smithsonian-Mason School of Conservation holds two residential undergraduate semesters, in which climate change is a learning module in both semesters (one focuses on ecological studies evaluating ecosystem responses to climate change; the other focuses primarily on the science of climate and community engagement related to climate change).	Undergraduate students	Formal	http://smconservation.gmu.edu/programs/undergraduate/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Smithsonian Institution				
Advanced Technological Education (ATE)	With an emphasis on two-year colleges, ATE focuses on the education of technicians for the high-technology fields that drive the nation's economy, through support for curriculum development, professional development of college faculty and secondary school teachers, and articulation of career pathways between high school, two-year colleges, and four-year institutions.	Undergraduate students	Formal (under-grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464
U.S. Department of Agriculture (USDA)				
Higher Education Challenge Grants	Grant program addressing national priorities in the development of higher education programs and curricula.	Land grant colleges and universities	Formal (undergrad/grad)	http://www.csrees.usda.gov/
U.S. Department of Energy (DOE)				
Advanced Vehicle Competitions	Multi-year competitions to challenge undergraduate engineering students to reengineer existing cars with advanced vehicle technologies to reduce fuel consumption and lower emissions. The objective is to stimulate the development of advanced-propulsion and alternative-fuel technologies and provide the training ground for the next generation of automotive engineers. The current competition—EcoCAR 2: Plugging In to the Future—which began in 2011 and will conclude in 2014, includes 15 universities from across North America. Student teams are using a 2013 Chevrolet Malibu as the integration platform for their advanced vehicle design.	Undergraduate students	Hands-on learning using an actual vehicle	http://www1.eere.energy.gov/vehiclesandfuels/deployment/education/index.html
Energy 101 Course Framework	A model, interdisciplinary, general energy course for college students in two- and four-year schools to explore systematically the science and social science behind sound energy decision making. Based on the Energy Literacy Framework.	Undergraduate students	Custom-izable online course framework	http://www1eere.energy.gov education/energy_101.html
Graduate Students, Professionals				
National Oceanic and Atmospheric Administration (NOAA)				
Climate and Society Masters Program	This program enables understanding of climate science, decision processes, and social needs to deliver management strategies that incorporate climate. Its core courses have been developed by the International Research Institute for Climate and Society, in collaboration with renowned Columbia University faculty in climate, engineering, policy, public health, economics, political science, statistics, psychology, sociology, and anthropology.	Graduate students	Formal	http://www.columbia.edu/cu/climatesociety/
National Weather Service (NWS) Training Program in Climate Services	NWS initiated a training program in climate services in 2001 to increase the knowledge base of its field staff. It included about 25 hours of online distance learning material, a 5-day virtual course on Climate Variability and Change, and a 3-day residence course on Operational Climate Services. Because of the continuing interest in global and regional climate variability and change, as well as their local impacts on socioeconomic development, the NWS training program is expanding.	Professionals, graduate students, educators	Training	http://www.nws.noaa.gov/om/csd/pds/DistanceLearning.shtml

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
National Science Foundation (NSF)				
Integrative Graduate Education and Research Traineeship Program (IGERT)	IGERT was developed to meet the challenges of educating U.S. Ph.D. scientists and engineers who will pursue careers in research and education, with interdisciplinary backgrounds; deep knowledge in chosen disciplines; and technical, professional, and personal skills to become, in their own careers, leaders and creative agents for change. IGERT has a strong focus on new models for graduate education that prepare students to contribute in new ways to benefit society.	Graduate students, professionals	Formal (grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759
Transforming Undergraduate Education in STEM (TUES)	TUES seeks to improve the quality of STEM education for all undergraduate students through projects with potential to transform education by bringing about widespread adoption of classroom practices that embody understanding of how students learn most effectively, develop faculty expertise, implement educational innovations, assess learning and evaluate innovations, prepare K–12 teachers, or conduct research on STEM teaching and learning.	Undergraduate students, professionals	Formal (undergrad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5741
U.S. Department of Energy (DOE)				
Graduate Automotive Technology Education (GATE)	GATE Centers of Excellence support the development of advanced multidisciplinary coursework, certificate, and degree programs in advanced vehicle technologies at competitively selected universities. Funds are also provided for research and development and laboratory experiences in critical automotive technologies to help develop next-generation expertise to overcome technology barriers preventing the development and production of cost-effective, high-efficiency U.S. vehicles. The awardees will focus on three critical automotive technology areas: hybrid propulsion, energy storage, and lightweight materials.	Graduate students	Classroom/ laboratory research	http://www1.eere.energy.gov/vehiclesandfuels/deployment/education/fcvt_gate.html
Undergraduate, Graduate, and Postgraduate Students, Professionals				
National Science Foundation (NSF)				
Antarctic Earth Sciences Program	Beneath its thick ice sheets, Antarctica is a dynamic and diverse continent with mountains, volcanoes, deserts, meteorites, dinosaur fossils, and some of Earth's most ancient crust. This program supports research to interpret this rich history and the processes that shape Antarctica today.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=8173
Antarctic Glaciology Program	This program is concerned with the study of the history and dynamics of all naturally occurring forms of snow and ice, including floating ice shelves, glaciers, and continental and marine ice sheets. Program emphases include paleoenvironments from ice cores, ice dynamics, numerical modeling, glacial geology, and remote sensing of ice sheets.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12798
Antarctic Ocean and Atmospheric Sciences	Antarctic oceanic and tropospheric studies focus on the structure and processes of the ocean–atmosphere environment and their relationships with the global ocean, atmosphere, and marine biosphere. As part of the global heat engine, the Antarctic has a major role in the world's transfer of energy. Its ocean–atmosphere system is known to be both an indicator and a component of climate change.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13422

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Arctic Natural Sciences Program	Areas of special interest include marine and terrestrial ecosystems, Arctic atmospheric and oceanic dynamics and climatology, Arctic geological and glaciological processes, and their connectivity to lower latitudes.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13424&org=NSF
Arctic Observing Network (AON)	Compared with much of the rest of Earth, the Arctic is a data-sparse region where large, rapid, and system-wide environmental change is occurring. The goal of AON is to enhance the environmental observing infrastructure required for the scientific investigation of Arctic environmental change and its global connections.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503222&org=NSF
Arctic Research Support and Logistics Program (RSL)	RSL supports the field component of research projects funded through NSF science programs. RSL accepts proposals that support long-term observations of the Arctic; support the acquisition of data sets useful to a broad segment of the Arctic research community; will lead to Cooperative Agreements to operate multi-use Arctic research facilities; or provide services that broadly support the Arctic research community, such as facilitating communication, developing research ideas in an Arctic-wide community setting, and cooperating with Arctic communities.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13437&org=NSF
Arctic-SEES	This multi-year, interdisciplinary program seeks both fundamental research that improves the ability to evaluate the sustainability of the Arctic human-environmental system, as well as integrated efforts that will provide community-relevant sustainability pathways and engineering solutions. For this competition, interdisciplinary research is focused in four thematic areas: the natural and living environment, the built environment, natural resource development, and governance.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503604
Arctic Social Sciences (ASSP)	ASSP encompasses all social sciences supported by NSF, including anthropology, archaeology, economics, geography, linguistics, political science, psychology, science and technology studies, sociology, traditional knowledge, and related subjects.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13425
Arctic System Science (ARCSS) Program	The Arctic comprises a complex, tightly coupled system of air, ice, ocean, land, and people. The system behaves in ways not fully understood, and has demonstrated the capacity for rapid and unpredictable change with global ramifications. Because the Arctic is pivotal to Earth's dynamics, ARCSS's goal is to advance understanding of this complex and interactive system.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13426
Climate and Large-Scale Dynamics (CLD)	CLD's goals are to (1) advance knowledge about the processes that force and regulate the atmosphere's synoptic and planetary circulation, weather, and climate; and (2) sustain the pool of human resources required for excellence in synoptic and global atmospheric dynamics and climate research.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11699
Decadal and Regional Climate Prediction Using Earth System Models (EaSMs)	This program supports the development and application of next-generation EaSMs that include coupled and interactive representations of such things as ocean and atmospheric currents, human activities, agricultural working lands and forests, urban environments, biogeochemistry, atmospheric chemistry, the water cycle, and land ice. The program seeks to attract scientists from the disciplines of geosciences, social sciences, agricultural and biological sciences, mathematics and statistics, physics, and chemistry. Partners: USDA, DOE	Undergraduate students, graduate students, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503399%5Barchived%5D

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Decision, Risk and Management Sciences (DRMS)	DRMS supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; and management science and organizational design.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423
Dimensions of Biodiversity	This campaign's goal is to transform, by 2020, how the scope and role of life on Earth are described and understood. The campaign promotes novel, integrated approaches to identify and understand the evolutionary and ecological significance of biodiversity amidst the changing environment of the present and in the geologic past. This campaign seeks to characterize Earth's biodiversity by using integrative, innovative approaches to fill the most substantial gaps in understanding of the diversity of life on Earth. The campaign takes a broad view of biodiversity, and currently focuses on the integration of genetic, taxonomic/phylogenetic, and functional dimensions of biodiversity. Partner: NASA	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446
Emerging Topics in Biogeochemical Cycles	Proposals should be interdisciplinary and should address biogeochemical processes and dynamics within and/or across one or more of the following systems: terrestrial, aquatic, and atmospheric. NSF encourages proposals that focus on nonlinear dynamics and/or on interactions and thresholds in climate, ecological, and/or hydrological systems. Goals of this effort are to increase understanding of how biological systems respond to changing physical and chemical conditions, and how biological systems influence the physical and chemical characteristics of soils and sediments, air, or water.	Undergraduate students, graduate students, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/pubs/2009/nsf09030/nsf09030.jsp
Energy for Sustainability	This program supports fundamental research and education in energy production, conversion, and storage, and is focused on environmentally friendly and renewable energy sources.	Undergraduate students, graduate students, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501026
Environmental Engineering	This program encourages transformative research that applies scientific and engineering principles to avoid or minimize solid, liquid, and gaseous discharges resulting from human activity into land, inland and coastal waters, and air, while promoting resource and energy conservation and recovery.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501029
Environmental Sustainability	This program supports engineering research with the goal of promoting sustainable, engineered systems that enhance human well-being and are compatible with sustaining natural (environmental) systems that provide ecological services vital for human survival. The long-term viability of natural capital is critical for many areas of human endeavor. Environmental sustainability research typically considers long time horizons and may incorporate contributions from the social sciences and ethics. Research areas include industrial ecology, green engineering, ecological engineering, and Earth systems engineering.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501027

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Ethics Education in Science and Engineering (EESE)	EESE funds research and education projects that improve ethics education in all fields of science and engineering supported by NSF, with priority given to interdisciplinary, inter-institutional, and international contexts.	Undergraduate students, graduate students, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13338
Frontiers in Earth System Dynamics (FESD)	Earth is often characterized as "dynamic," because its systems are variable over space and time, and they can respond rapidly to multiple perturbations. FESD's goals are to (1) foster an interdisciplinary and multiscale understanding of the interplay among and within Earth's various subsystems, (2) catalyze research in areas poised for a major advance, (3) improve data resolution and modeling capabilities to more realistically simulate complex processes and forecast disruptive or threshold events, and (4) improve knowledge of the resilience of Earth and its subsystems.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503525
Integrated Earth Systems (IES)	IES focuses on the continental, terrestrial, and deep Earth subsystems of the whole Earth system, with the goal of supporting collaborative, multidisciplinary research into the operation, dynamics, and complexity of Earth systems and subsystems at all temporal and spatial scales.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504833
Multi-scale Modeling (MSM)	MSM supports projects that focus on the development and/or integration of environmental models that link local, regional, and global scales. Proposals are encouraged that have the potential to dramatically improve understanding of how small- and large-scale processes lead to nonlinearities and activation thresholds, as well as to improve predictive capabilities. Projects could address such topics as the carbon cycle, climate, population dynamics, food webs, biodiversity, biogeochemical cycles, and hydrological processes.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/pubs/2009/nsf09032/nsf09032.jsp
NSF Science, Engineering and Education for Sustainability Fellows	Through this program, NSF seeks to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and human well-being, while creating the necessary workforce to address these challenges. The program's emphasis is to facilitate investigations that cross traditional disciplinary boundaries and address issues of sustainability through a systems approach, building bridges among academic inquiry, economic growth, and societal needs.	Professionals	Formal (post-doctoral)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504673
Paleoclimate	This program supports research on the natural evolution of Earth's climate, with the goal of providing a baseline for present variability and future trends through improved understanding of the physical, chemical, and biological processes that influence climate over the long term.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12727
Paleo Perspectives on Climate Change	The goal of research is to utilize key geological, chemical, and biological records of climate system variability to provide insights into the mechanisms and rates of change that characterized Earth's past climate variability, the sensitivity of Earth's climate system to changes in forcing, and the response of key components of Earth's system to these changes.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5750

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Research Coordination Networks (RCN)	RCN's goal is to advance a field or create new directions in research or education by supporting groups of investigators to communicate and coordinate their research, training, and educational activities across disciplinary, organizational, geographic, and international boundaries. RCN provides opportunities to foster new collaborations, including international partnerships, and address interdisciplinary topics. Innovative ideas for implementing novel networking strategies, collaborative technologies, and development of community standards for data and meta-data are especially encouraged.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11691&org=GEO&from=home
Sustainable Energy Pathways (SEP)	SEP calls for innovative, interdisciplinary basic research in science, engineering, and education by teams of researchers for developing systems approaches to sustainable energy pathways based on a comprehensive understanding of the scientific, technical, environmental, economic, and societal issues. The SEP solicitation considers scalable approaches for sustainable energy conversion to useful forms, as well as its storage, transmission, distribution, and use.	Undergraduate students, graduate students, professionals	Formal (K-12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504690
Water Sustainability and Climate (WSC)	WSC's goal is to enhance the understanding of and predict the interactions between the water system and land-use changes (including agriculture, managed forests, and rangeland systems), the built environment, ecosystem function and services, and climate change/variability through place-based research and integrative models. Studies of the water system using models and/or observations at specific sites, singly or in combination, that allow for spatial and temporal extrapolation to other regions, as well as integration across the different processes in that system, are encouraged, especially to the extent that they advance the development of theoretical frameworks and predictive understanding.	Undergraduate students, graduate students, professionals	Formal (undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503452
Smithsonian Environmental Research Center (SERC)				
Internship Program	The theme of SERC's 2013 NSF-funded internship program is "Global Change Ecology at the Smithsonian Environmental Research Center." Many of the intern research projects will relate to climate change.	Undergraduate students, graduate students	Formal	http://www.serc.si.edu/pro_training/index.aspx
Professional Development	SERC research labs, including the Biogeochemistry Lab working in the Global Change Research Wetland, bring on 30–50 interns and postdoctoral students annually for professional training. The Biogeochemistry Lab is currently testing how higher carbon dioxide and sea level rise could change the research site in the year 2100.	Undergraduate students, graduate students, professionals	Formal, training	http://www.serc.si.edu/labs/biogeochem/research_wetland.aspx
U.S. Department of Energy (DOE)				
EERE Postdoctoral Research Awards	The awards aim to create the next generation of scientific leaders in energy efficiency and renewable energy by attracting the best scientists and engineers to pursue breakthrough technologies.	Postgraduate students	Laboratory, conferences	http://www.windpoweringamerica.gov/schools/projects.asp
Department of Energy Solar Decathlon	The decathlon educates student participants and the public about the environmental benefits and cost-saving opportunities presented by clean-energy products; demonstrates to the public the accessibility and affordability of cost-effective homes that combine energy-efficient construction and appliances with renewable energy systems that are available today; and provides participating students with unique training that prepares them to enter the nation's clean-energy workforce.	Undergraduate and graduate students, educators	National competition	http://www.solardecathlon.gov/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Geothermal Student Competition	This competition is designed to advance the understanding of geothermal energy. Students form an interdisciplinary team to develop a business plan for creating a geothermal enterprise in their local areas.	Undergraduate and graduate students	Online	http://orise.orau.gov/science-education/capabilities/science-education-events/eere-geothermal-student-competition.aspx
Hydro Research Fellowships Program	The program is designed to stimulate student research and academic interest in research and careers in conventional or pumped storage hydropower. The research seeks to advance knowledge about hydroelectric technology, including efficiency improvements and environmental mitigation.	Postgraduate students	Research and training	http://www.hydrofoundation.org/fellowshipOverview.html
Informal Educators, Public				
National Aeronautics and Space Administration (NASA)				
Earth to Sky: Climate Change Professional Development for Informal Educators	This ongoing and expanding partnership provides professional development for informal educators to access and use relevant NASA science, data, and educational products in their work. Partners: DOI/NPS, USFWS	Informal educators	Training	http://www.earthtosky.org/
National Oceanic and Atmospheric Administration (NOAA), Office of Education (OEd)				
Ocean Education Grants for AZA Aquariums	OEd issued a request for applications to support education projects designed to engage the public in activities that increase ocean and/or climate literacy and the adoption of a stewardship ethic.	Informal educators	Informal	http://www.oesd.noaa.gov/funding_opps.html
Science On a Sphere Collaborative Users Network	Science On a Sphere (SOS)® is a spherical display system, approximately 6 feet in diameter, that shows "movies" of animated Earth system dynamics (http://www.sos.noaa.gov/). NOAA's Office of Education supports the use of spherical display systems, such as SOS, in public exhibits as part of a focused effort to increase environmental literacy. The institutions that currently have NOAA's SOS, as well as other partners who are creating content and educational programming for these systems, have formed a collaborative network. Partners: NASA, DOE	Informal educators, public	Informal	http://www.oesd.noaa.gov/network/
National Science Foundation (NSF)				
Advancing Informal STEM Learning (AISL)	AISL invests in research and development of innovative and field-advancing out-of-school STEM learning and emerging STEM learning environments. Funding is provided for projects that advance understanding of informal STEM learning, develop and implement innovative strategies and resources for informal STEM education, and build the national professional capacity for research, development, and practice in the field.	Informal education, public	Informal	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504793
Formal/Informal Educators				
Smithsonian Institution				
Arctic Studies Center	Established in 1988, the center is the only U.S. government program with a special focus on northern cultural research and education. In keeping with this mandate, the center specifically studies northern people, exploring history, archaeology, social change, and human lifeways across the circumpolar world. The center conducts various outreach activities that relate to climate change issues, including exhibitions and conferences.	K–12 students, K–12 teachers, public, professionals	Informal	http://www.mnh.si.edu/arctic/index.html

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Evolution of Terrestrial Ecosystems (ETE) Program	ETE investigates Earth's land biotas throughout their 400-million-year history. The program's goal is to understand how terrestrial ecosystems have been structured and have changed over geologic time. Using the fossil record, ETE scientists study the characteristics of ecological communities and the changing dynamics of ecosystems. Paleoecological analyses determine patterns through time in community structure and composition, investigate the effects of ecological change on individual lineages, and relate patterns of stasis or change to environmental and other processes that influence ecosystem formation, sustainability, and collapse. The ETE program conducts a variety of outreach activities, including hosting workshops, meetings, and conferences; teaching courses at area universities; and providing content for various museum exhibits.	K–12 students, K–12 teachers, undergraduate students, graduate students, public, professionals	Formal, informal	http://www.mnh.si.edu/ete/
U.S. Environmental Protection Agency (EPA)				
Environmental Education Grant Program	EPA's Environmental Education Division distributes more than $3 million annually to formal and informal education organizations across the nation to provide environmental education programs to learners of all ages. Many of these grants have gone to climate change education programs over the last several years, including public school districts, privately run nature centers, public and private colleges and universities, and community organizations.	Formal/ informal educators	Formal/ informal	www.epa.gov/enviroed/
U.S. Global Change Research Program (USGCRP)				
Climate Change, Wildlife and Wildlands Toolkit for Formal and Informal Educators	The new toolkit is an updated and expanded version of the award-winning *Climate Change, Wildlife and Wildlands Toolkit for Teachers and Interpreters*, first published in 2001 (2001 Public Relations Society of America Bronze Anvil Award for Interactive Communications and 2002 Telly Award). The toolkit is very popular, with more than 40,000 kits distributed in all 50 states and U.S. territories and over a dozen countries across the world. The toolkit profiles climate stewards in all 11 ecoregions. Here, students participate in the Baldwin County Grasses in Classes program to help grow native plants for wetland and dune restoration projects. The new kit is designed for classroom teachers and informal educators in parks, refuges, forestlands, nature centers, zoos, aquariums, science centers, etc., and is aimed at the middle school grade level. In partnership with the National Park Service, the U.S. Fish and Wildlife Service, NOAA, NASA, the U.S. Forest Service, and the Bureau of Land Management, EPA developed this toolkit to aid educators in teaching how climate change is affecting the nation's wildlife and public lands, and how everyone can become climate stewards.	Formal/ informal educators	Formal/ informal	http://globalchange.gov/resources/educators/toolkit/
Climate Literacy: The Essential Principles of Climate Sciences—A Guide for Individuals and Communities	This guide presents important information for individuals and communities to understand Earth's climate, impacts of climate change, and approaches for adapting to and mitigating climate change. Principles in the guide can serve as discussion starters or launching points for scientific inquiry. The guide can also serve educators who teach climate science as part of their science curricula. A guide is available to help individuals of all ages understand how climate influences them—and how they influence climate. A product of USGCRP, the guide was compiled by an interagency group led by NOAA.	Formal/ informal educators	Formal/ informal	http://globalchange.gov/resources/educators/climate-literacy

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Office of Education: Environmental Literacy Grants program	NOAA's Office of Education issued a request for applications for projects designed to build the capacity of informal educators (including interpreters and docents) and/or formal educators (pre- or in-service) to use NOAA data and data access tools to help K–12 students and/or the public understand and respond to global change. Successful projects will enhance educators' ability to use the wealth of scientific data, data visualizations, data access technologies, information products, and other assets available through NOAA (plus additional sources, if desired) to engage K–12 students and/or other members of the public.	Formal/ informal educators	Formal/ informal	http://www.oesd.noaa.gov/funding_opps.html
Professionals				
National Oceanic and Atmospheric Administration (NOAA)				
Building Capacity for Communicating about Climate	NOAA established a voluntary team to enhance the ability of NOAA personnel and partners to communicate about climate science issues. The team creates opportunities for interested staff and partners to learn about Earth's climate and how it influences our lives, and to become more conversant about NOAA's climate products, information, and services. The team engages staff through webinars, workshops, and an e-newsletter.	Professionals	Informal	https://sites.google.com/a/noaa.gov/building-capacity-for-conversing-about-climate/
Climate Communications Workshops	In the spring of 2013, NOAA and the Cooperative Institute for Climate and Satellites organized several workshops at locations around the nation to (1) build climate communications capacity among NOAA staff and partners so that they are better able to converse about climate science issues, (2) provide communications and climate resources to staff that will help them prepare and respond to questions about climate, and (3) empower staff with the tools, techniques, and tactics to respond to questions about climate science.	Professionals	Informal	http://cicsnc.org/events/
Coastal Resource Managers Training and Capacity Building	NOAA's National Ocean Service Coastal Services Center works with other federal agencies to impart information, services, and technology to the nation's coastal resource managers. This community includes state coastal zone management and natural resource management offices, research reserves, sanctuaries, and Sea Grant offices. Each of these organizations has the difficult task of helping coastal communities balance the often competing demands for coastal resources.	Professionals	Training	http://oceanservice.noaa.gov/topics/coasts/training/
Coastal Training Program	The program provides up-to-date scientific information and skill-building opportunities to individuals who are responsible for making decisions that affect coastal resources. The program helps National Estuarine Research Reserves ensure that coastal decision makers have the knowledge and tools they need to address critical resource management issues of concern to local communities.	Professionals	Training	http://www8.nos.noaa.gov/publicnerrs/training.aspx

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Monthly U.S. and Global Climate Report	NOAA's National Climate Center develops monthly U.S. and global climate reports to analyze the previous month's conditions and provide additional seasonal and annual analyses. The reports present monthly statistics on surface temperature and precipitation, including ranks and patterns, as well as comparable data for the last three and six months and year to date. They also include subreports on tornadoes, wildfire, snow cover, major winter storms, and typically an update to the most recent U.S. Drought Monitor Report. A monthly call to media and stakeholders supplements these reports.	Public, professionals	Informal	http://www.ncdc.noaa.gov/sotc/
Regional Integrated Science and Assessment (RISA) Program	RISA supports research teams that conduct interdisciplinary and regionally relevant assessments to inform resource management, planning, and public policy. RISA teams help build the nation's capacity to prepare for and adapt to climate variability and change by providing cutting-edge scientific information to public and private user communities.	Public, professionals	Informal	http://cpo.noaa.gov/ClimatePrograms/ClimateSocietalInteractionsCSI/RISAProgram.aspx
Responding to Climate Change: A Workshop for Coral Reef Managers	Resources from a global series of workshops are distributed to coral reef managers to support their learning of how to predict where coral bleaching will occur, measure coral reef resilience, and assess the socioeconomic impacts of climate damage. The workshops aim is to help managers develop response strategies for coping with climate change. The workshops are hosted by NOAA, the Great Barrier Reef Marine Park Authority, and The Nature Conservancy, who partnered with the World Conservation Union in producing *A Reef Manager's Guide to Coral Bleaching,* the book that inspired these workshops.	Professionals	Training	http://coralreefwatch.noaa.gov/satellite/education/workshop/index.html
Yearly State of the Climate Report	NOAA scientists serve as the lead editors on this international, peer-reviewed annual report, which is the authoritative summary of the global climate of the previous year. In 2011, the report used 43 climate indicators to track and identify changes and overall trends in the global climate system, and was compiled by 378 scientists from 48 countries around the world.	Public, professionals	Informal	http://www.ncdc.noaa.gov/bams-state-of-the-climate/2011.php
Smithsonian Institution				
The Anthropocene: Planet Earth in the Age of Humans	The Consortia hosted a symposium on October 11, 2012, to address the tremendous scope of transformations now occurring on Earth with profound effects on plants, animals, and natural habitats. Geologists have proposed the term Anthropocene, or "Age of Man," for this new period in the history of the planet. The symposium focused on the arrival and impact of this new era through the lenses of science, history, art, culture, philosophy, and economics, and promoted discussion, debate, and deliberation on these issues of change.	Public, professionals	Informal	http://www.si.edu/consortia
Environmental Leadership Training Initiative (ELTI)	The Smithsonian Tropical Research Institute's (STRI's) Environmental Leadership Training Initiative, in partnership with Yale University, has hosted a variety of training programs related to climate change. ELTI provides policy-makers, individuals in technical positions, community representatives, indigenous leaders, and others with the knowledge, skills, and tools to conserve and restore forest ecosystems and biodiversity in tropical regions of Latin America and Asia. Partner: Yale University	Professionals	Training	http://environment.yale.edu/elti/en/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
[Hong Kong and Shanghai Banking Corporation] HSBC Climate Partnership	The HSBC Climate Partnership was a multi-year initiative that brought together STRI, The Climate Group, Earthwatch Institute, and the World Wildlife Fund in a partnership to address the threat of climate change. This initiative employed a participatory citizen science model in which HSBC employees worked alongside scientists from STRI and other partners to collect data from five distinct forest sites around the world to better understand how global forests respond to climate change. This citizen science model was used to educate HSBC employees about climate change and inspire them to take action to address it. Partner: HSBC	Professionals	Training	http://www.theclimategroup.org/programs/hsbc-climate-partnership/
International Outreach	Smithsonian Environmental Research Center (SERC) ecologists conduct a variety of international outreach activities related to climate change. For example, Dr. John Parker spent two weeks in India teaching Buddhist monks about climate change as part of the Science for Monks program. In addition, Dr. Pat Megonigal and his lab went to Abu Dhabi to research how well its coasts were burying carbon, and in the process conducted professional training with approximately 20 volunteers.	Public, professionals	Informal, training	http://www.serc.si.edu/index.aspx
Roger Revelle Commemorative Lecture Presented by The National Academies' Ocean Studies Board	The 2013 Roger Revelle Commemorative Lecture, "Melting Ice: What is happening to Arctic sea ice and what does it mean for us," explored the impacts of recent decreases in Arctic summer sea ice and how these decreases may already be affecting the larger climate system through a variety of physical, dynamical, and ecological processes. The featured speaker was Dr. John E. Walsh, Chief Scientist at the International Arctic Research Center. The lecture was sponsored by several organizations, including the University of Wisconsin-Madison's Space Science and Engineering Center. Partners: ONR, USGS, NSF, NASA, NOAA	Public, professionals	Informal	http://nas-sites.org/revellelecture/
Smithsonian Institution Global Earth Observatory (SI-GEO)	SI-GEO is a worldwide tree survey involving roughly 48 forest plots across the globe. SERC recruits volunteer "citizen scientists" to help survey the 33,500 trees in their SI-GEO forest plot. Through 2011, SERC partnered with Earthwatch on volunteer recruitment. Earthwatch recruited HSBC employees to participate, and volunteers spent a week at SERC learning about climate change and helping scientists in the field.	Public, professionals	Training	http://www.sigeo.si.edu/
U.S. Department of Agriculture (USDA), U.S. Forest Service (USFS)				
Climate Change Resource Center: Information and Tools for Land Managers	The center is a joint project of USFS's Pacific Northwest and Rocky Mountain Research Stations. This Web-based resource summarizes climate change research for resource managers and provides implications for management based on the scientific findings. It also contains video presentations from scientists describing their findings.	Professionals	Formal/informal	http://www.fs.fed.us/ccrc/
Eastern Forest Environmental Threat Assessment Center	The center provides regional online access to the general public and land managers.	Professionals	Formal/informal	http://www.forestthreats.org/climate-change

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
i-Tree	i-Tree is a state-of-the-art, peer-reviewed software suite from USFS that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help professionals in communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide, including those that mitigate the effects of climate change.	Public/ professionals	Formal/ informal	http://www.itreetools.org/
USFS/IUFRO Task Force on Traditional Forest Knowledge	The USFS Research & Development and IUFRO (International Union of Forest Research Organizations) Task Force provide information on traditional forest knowledge and practices related to climate change.	Public/ professionals	Formal/ informal	http://www.iufro.org/science/task-forces/traditional-forest-knowledge/
Western Wildland Environmental Threat Assessment Center	The center provides regional online access to the general public and land managers.	Professionals	Formal/ informal	http://www.fs.fed.us/wwetac/threats/climate_change.html
U.S. Department of Energy (DOE)				
Energy 101	This on-demand training course provides an introduction to federal energy management. The training is designed for new federal energy managers and others wanting an overall introduction to renewable energy, energy efficiency, and water efficiency. Attendees receive an overview of energy management, energy efficiency, renewable energy, and water efficiency; and learn about the legislative basis for federal energy management, the process for starting energy management projects, how to establish baseline energy and water measurements, developing action plans, and project financing mechanisms and options.	Federal energy managers and their support contractors	Online course/ on-demand e-training	http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=6
Federal Greenhouse Gas Accounting and Reporting	This no-cost, on-demand training course provides an update on greenhouse gas (GHG) regulatory requirements, as well as strategies, models, and technology tools to measure GHG emissions. Attendees learn to identify key types and sources of federal GHG emissions; understand the emerging GHG accounting and reporting framework; align and integrate diverse agency activities, processes, and resources related to GHG reductions; and adopt and implement accepted methods for gathering reliable data to measure progress, evaluate results, and improve performance.	Federal energy managers and their support contractors	Online course/ on-demand e-training	http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=14
Home Energy Score	This tool provides homeowners with resources to identify trusted contractors who can help them understand their home's energy use, as well as identify home improvements that increase energy performance and improve comfort.	Assessors and auditors, potential partners	Webinars	http://www1.eere.energy.gov/buildings/residential/hes_past_ webinars.html
Residential Building Retrofit Information	This Web site provides information about guidelines for effective training for the following residential building retrofit careers: energy auditor, retrofit installer, technician, crew leader, and quality control inspector. It also provides a link to Guidelines for Quality Work for Single-Family, Multifamily, and Manufactured Housing Energy Upgrades.	Those interested in working to upgrade/ retrofit residential buildings	Online	http://www1.eere.energy.gov/wip/retrofit_guidelines_overview.html

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Solar Instructor Training Network (SITN)	Increasing quality and access to accredited photovoltaic (PV) training, SITN partners with more than 260 community colleges in eight regions (all 50 states, 2 U.S. territories) to train instructors in PV and electrical skills to a national standard. SITN also provides free inspection training to local, county, and state code officials regarding rooftop PV inspection practices that comply with all national building codes.	Community college PV instructors, municipal building inspectors	Web site	http://www1.eere.energy.gov/solar/sunshot/instructor_training_network.html
U.S. Department of Health and Human Services (HHS)				
CDC Climate and Health Program	This Web site provides information on Centers for Disease Control and Prevention activities and funding in climate and health, including resources and links for state and local health departments.	State and local health departments, public health professionals, and general public	Web site	http://www.cdc.gov/climateandhealth/default.htm
Climate Change and Extreme Heat Events Guidebook	Provides information on extreme heat events, projected impacts from increased extreme heat events, and how the public health community can protect the nation from these impacts.	Public health community	Outreach	http://www.cdc.gov/climateandhealth/pubs/ClimateChangeandExtremeHeatEvents.pdf
Climate Change: Mastering the Public Health Role	A series of webinars developed in conjunction with the American Public Health Association and other key national organizations on climate change topics of interest to public health practitioners, featuring presentations from leading experts and public health leaders.	State and local health departments, public health professionals	Live and archived online webinar series	http://www.cdc.gov/climatechange/webinar_series.htm
Climate and Health Program	Helps communities prepare for extreme heat. For example, approximately 1,000 U.S. public health officials participated in the May 23, 2013, webinar "Beating the Heat: Preparing for Extreme Heat Events at the State and Local Level," with presentations from representatives from the New York and North Carolina health departments.	State and local health departments, public health professionals, and general public	Outreach	N/A
Climate-Ready States and Cities Initiative (CRSCI) Launch	CRSCI aims to strengthen the capabilities of state and local health agencies to deal with the challenges associated with climate change; identify and forecast the public health impacts of climate change specific to their communities and geographic areas; understand gaps in their knowledge and program capabilities to respond to the forecasted public health impacts; identify new programs or tailored program adaptations needed to counter the forecasted impacts; and collect critical information to guide resource decisions that protect their communities.	State and local health departments, public health professionals	Live and online	http://www.cdc.gov/climateandhealth/climate_ready.htm
Health Impact Assessment (HIA) Training	This day-long training course demonstrates how to undertake an HIA on a climate change-related policy, with emphasis on understanding how climate change-related policies can impact public health, and key considerations when assessing and providing recommendations based on the health impacts of a policy relevant to climate change.	State and local health departments, public health professionals	Training	N/A
U.S. Department of the Interior (DOI)				
Climate Friendly Parks Program	Through this joint partnership between EPA and the National Park Service (NPS), Climate Friendly Parks from around the country are leading the way to protect U.S. parks' natural and cultural resources and ensure their preservation for future generations. Partner: EPA	Professionals	Training	http://www.nps.gov/climatefriendlyparks/index.html

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Climate Leadership In Parks (CLIP)	CLIP is an Excel-based calculator designed for parks to assess their own greenhouse gas (GHG) emissions. It focuses on in-park operational activities—electricity use, transportation, waste and wastewater treatment, and "other" GHG-emitting activities inside parks. While the tool has a method to calculate forest carbon flux, it is not up to date or specific enough to adequately represent park forest carbon storage/emissions. For parks that want to include forest carbon in their reporting, NPS recommends that they use the latest forest models to calculate the flux, and then enter the numbers into the CLIP tool.	Professionals	Training	http://www.nps.gov/climatefriendlyparks/index.html
Regional Climate Change Response Centers	Eight DOI regional Climate Change Response Centers—serving Alaska, the Northeast, the Southeast, the Southwest, the Midwest, the West, Northwest, and Pacific regions—will synthesize existing climate change impact data and management strategies, help resource managers put them into action on the ground, and engage the public through education initiatives.	Professionals	Training	http://www.doi.gov/news/09_News_Releases/091409.html
U.S. Department of Transportation (DOT)				
Adaptation Peer Exchange (June 29 and November 6, 2012, and February 12 and May 21, 2013)	These webinars provide an opportunity for information exchange and peer review/input from each of the pilot projects. Each pilot presents to all others (about 30–40 people) on the webinar (usually for about 10–15 minutes) regarding the work they have completed thus far, the information they have gathered, and lessons learned/best practices.	Professionals (transit agencies, state and local governments)	Webinars	http://www.fhwa.dot.gov/environment/climate_change/adaptation/webinars/
Aviation Climate Change Research Initiative (ACCRI)	Measures and tracks fuel efficiency from aircraft operations, and provides the data for assessing improvements in aircraft and engine technology, operational procedures, and the airspace transportation system that reduce aviation's contribution to CO_2 emissions. A major ACCRI goal is to reduce key scientific uncertainties in quantifying aviation-related climate impacts and provide timely scientific input to inform policymaking decisions for the Federal Aviation Administration's (FAA's) NextGen Program.	Professionals (aviation stakeholders)	Web site	http://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/accri/
Climate Change Adaptation Initiative	Web page provides information on Federal Transit Administration (FTA) efforts regarding climate change adaptation; published reports, policy statements, and letters; past events and workshops related to transit adaptation to climate change; and current activities taking place (including information on the seven FTA climate adaptation pilot projects).	Professionals (transit agencies, state and local governments, public)	Web site	http://www.fta.dot.gov/adaptation
Getting on the Right Track: Real-World Approaches to Climate Change Adaptation (Workshop March 21–22, 2012)	This workshop was held in conjunction with the American Public Transportation Association and included a discussion of the 2012–2013 FTA climate adaptation pilot projects.	Professionals (transit agencies, state and local governments)	Formal/informal	http://www.fta.dot.gov/sitemap_14257.html
Climate Change Forums	An ongoing series produced by the Center for Climate Change and Environmental Forecasting to raise the awareness of American industry, government, and nonprofit organizations. In 2011, the center hosted two sessions for all DOT employees on the need for climate adaptation in transportation and on regional climate projections and why they matter to transportation.	Professionals (government employees)	Classroom/briefing style	http://www.climate.dot.gov

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Environmental Management Systems (EMS) Training	Organizations use EMS to continually assess and reduce the environmental impact of their operations, including their carbon footprint. Training and technical assistance include workshops, on-site technical support visits, electronic software, and consultation. During the 18-month training period, each agency will develop an EMS suited to its needs.	Professionals (transit agencies)	Workshops, on-site technical support visits, electronic software, and consultation	http://www.fta.dot.gov/planning/environment/planning_environment_227.html
Highways and Climate Change	Provides information on Federal Highway Administration (FHWA) research, publications, and resources related to climate change science, policies, and actions. Also presents some current state and local practices for adapting to climate change and reducing greenhouse gas emissions.	Professionals (state DOTs, local transportation agencies, MPOs, public)	Web site	http://www.fhwa.dot.gov/hep/climate/index.htm
Highways and Climate Change Newsletter	Provides information on the most recent issues and activities related to transportation and climate change.	Professionals (state DOTs, local transportation agencies, MPOs, public)	Formal/informal	http://www.fhwa.dot.gov/hep/climatechange/newsletter/index.htm
National Transit Institute (NTI), at Rutgers, The State University of New Jersey	Funded by FTA, NTI provides training, education, and clearinghouse services in support of U.S. public transportation and quality of life. NTI courses on transportation planning, environmental review, transit-oriented development, and transportation and land use are particularly relevant to climate change issues.	Professionals (transit agency staff, public transportation, transit industry, private companies)	Classroom and online courses	http://www.ntionline.com/
Outreach through conferences	FTA organizes, sponsors, and participates in numerous conferences as part of its outreach efforts, including conferences and sessions geared toward education on environmental and climate change issues. In the last year, FTA sponsored and participated in climate change panels at the annual Transportation Research Board conference, the Rail-volution conference, the American Public Transportation Association sustainability workshop, and the New Partners for Smart Growth Conference.	Professionals (transit agencies, state and local governments, academics)	Conferences	http://www.fta.dot.gov/news/news_events_415.html
Partnership for AiR Transportation Noise & Emissions Reduction (PARTNER)	A leading aviation cooperative research organization and an FAA/NASA/Transport Canada-sponsored Center of Excellence, PARTNER fosters breakthrough technological, operational, policy, and workforce advances for the betterment of mobility, economy, national security, and the environment. PARTNER comprises nine universities and 51 advisory board members. Many of its efforts have led to outreach and educational initiatives. PARTNER has funded the research of more than 200 master's and Ph.D. students, many in climate research. Partners: NASA, Transport Canada	Professionals (aviation stakeholders, including airlines, airports, manufacturers, the public, and government organizations)	Formal/informal	http://www.partner.aero

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Peer Exchanges on Transportation and Climate Change	FHWA is hosting peer exchanges for information sharing among 19 climate resilience pilots at state departments of transportation (DOTs) and metropolitan planning organizations (MPOs).	Professionals (state DOTs, local transportation agencies, MPOs, public)	Formal/ informal	http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_ and_current_research/vulnerability_assessment_pilots/index.cfm; http://www.fhwa.dot.gov/environment/climate_ change/adaptation/workshops_and_peer_exchanges/
Systematic Impacts of Climate Change Conference (October 11–12, 2012)	This two-day workshop examined the systematic effects of climate change on the national transportation systems, and identified what previous and current research has identified about climate change, what gaps exist in the research, and what researchers want to explore further.	Professionals from the transportation sector, and academics	Classroom/ briefing style	N/A
Transit and Climate Change Adaptation (August 8, 2011)	Discussed how climate change has implications for the planning process and asset management programs, as well as project-level design considerations in the transit realm. Guest speakers included representatives from the New York and Los Angeles Metropolitan Transportation Authorities.	Professionals (transit agencies, state and local governments)	Webinar	http://www.fta.dot.gov/documents/FTA_Climate_Change_Adaptation_Webinar_Notes_AUgust_8.pdf; http://www.fta.dot.gov/sitemap_14078.html
Transit and Environmental Sustainability	Provides information on transit's role in environmental sustainability, FTA sustainability efforts, resources and tools, and a clearinghouse of transit agency practices.	Professionals (transit agencies, state and local governments)	Web site	http://www.fta.dot.gov/13835.html
Transportation and Climate Change	FHWA periodically hosts webinars on transportation and climate change adaptation and mitigation. FHWA is currently hosting a series of public webinars on adapting transportation systems to climate change impacts.	Professionals (state DOTs and MPOs)	Webinars	http://www.fhwa.dot.gov/environment/climate_change/mitigation/webinars/; http://www.fhwa.dot.gov/environment/climate_change/adaptation/webinars/
Using Asset Management to Adapt to Weather Extremes: Lessons Learned from Transport for London (TfL) (December 15, 2011)	Transportation systems "on both sides of the pond" face challenges with bringing assets up to a state of good repair while dealing with extreme weather and changing climates. Flooding and heat waves further stress aging assets. TfL manages London's buses, road network, underground rail, and above-ground rail. TfL engineers and specialists describe how their agency has integrated climate impacts into asset management systems to better adapt transportation infrastructure and operations to risks. Presenters explain TfL risk assessments, asset management processes, highways drainage hotspot identification, and adaptive design of future assets, such as floodproofing for a major new construction project.	Professionals (transit agencies, state and local governments)	Webinar	http://www.fta.dot.gov/sitemap_14127.html

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
U.S. Environmental Protection Agency (EPA)				
Climate Change Indicators in the United States	In December 2012, EPA updated *Climate Change Indicators in the United States*. Available in print and online, this popular report presents 26 indicators that track observed signs of climate change. The indicators focus primarily on the U.S., but in some cases global trends are presented to provide context or a basis for comparison. The indicators are divided into five chapters: Greenhouse Gases, Weather and Climate, Oceans, Snow and Ice, and Human Society and Ecosystems. The Indicators are based on peer-reviewed data from various government agencies, academic institutions, and other organizations.	Public/ professionals	Formal/ informal	http://epa.gov/climatechange/science/indicators/
Climate Ready Estuaries (CRE) Program	CRE works with the National Estuary Program (NEP) and the coastal management community to assess climate change vulnerabilities, develop and implement adaptation strategies, and engage and educate stakeholders. CRE shares NEP examples to help other coastal managers, and provides technical guidance and assistance about climate change adaptation. The CRE Web site offers information on climate change impacts to different estuary regions, access to tools and resources to monitor changes, and information to help managers develop adaptation plans for estuaries and coastal communities.	Public/ professionals	Training	www.epa.gov/cre
ENERGY STAR for Existing Residential Homes	ENERGY STAR educates and empowers American homeowners with information about the actions they can take to reduce GHG emissions by improving the energy efficiency of their homes. Since 2009, EPA has offered two online tools for home energy savings: the Home Energy Yardstick, which allows homeowners to compare their homes' energy use with others across the country; and the interactive ENERGY STAR Home Advisor, which provides homeowners customized recommendations for improving the energy efficiency of their homes.	Public, home improvement contractors	Online tools, Web site, written collateral (factsheets, brochures, etc.)	http://www.energystar.gov/homeimprovement
EPA/Institute for Tribal Environmental Professionals (ITEP)	Through a cooperative agreement with ITEP at Northern Arizona University, EPA has supported development of a national climate change adaptation planning training program and online resources for tribes. In the first two years of the agreement, 87 people from 62 tribes or tribal organizations have been trained in developing adaptation plans to prepare for the expected impacts of climate change.	Tribes and tribal organizations, public officials	Formal/ informal	http://www4.nau.edu/tribalclimatechange/
Public				
National Oceanic and Atmospheric Administration (NOAA)				
NOAA@NSIDC (National Snow and Ice Data Center)	NSIDC manages about 60 NOAA data sets, and publishes several new data sets each year, with an emphasis on *in situ* data, digitizing old and sometimes forgotten but valuable analog data, and data sets from operational communities, such as the U.S. Navy. NSIDC also helps develop educational pages, created Google Earth™ files that enable the public to overlay data-based images on a virtual globe, and houses many photographic prints of glaciers, taken from the air and the ground. Partners: NSF, NASA	Public	Informal	http://nsidc.org/data/virtual_globes/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Sea Grant Office	Administered through NOAA, the National Sea Grant Program is a nationwide network of 32 university-based programs that work with coastal communities. Sea Grant College engages this network of the nation's top universities in conducting scientific research, education, training, and extension projects designed to foster science-based decisions about the use and conservation of natural resources and to increase coastal resiliency. The Sea Grant network is engaged in a multifaceted and diverse series of programs to address climate change in coastal and Great Lakes regions.	Public	Formal/ informal	http://www.seagrant.noaa.gov/
National Science Foundation (NSF)				
Antarctic Artists and Writers	This program supports writing and artistic projects specifically designed to increase understanding and appreciation of the Antarctic and of human activities on the southernmost continent.	Public	Informal	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503518
Smithsonian Institution				
GEO-Panamá	The Smithsonian Tropical Research Institute (STRI) contributed to GEO-Panamá, a series of publications that appeared in *La Prensa*, a major newspaper in Panama. This series touched on issues related to climate change, including ocean level rise in Panama City.	Public	Informal	http://www.stri.si.edu/english/about_stri/headline_news/news/article.php?id=684
Green Revolution	The Smithsonian Institution Traveling Exhibition Service has partnered with Chicago's Museum of Science and Industry to present Green Revolution, a fully digital exhibition that gives host organizations the power to build (and control) their own "eco-zibit." Green Revolution is a multiplatform initiative that focuses on several major themes: waste, energy, green pioneers, gardening and composting, green construction, and our carbon footprint.	Public	Informal	http://www.sites.si.edu/greenRevolution/index.htm
Nuestra casa en el universo	STRI communication associate Jorge Ventocilla and Catherine Potvin, from McGill University, edited a 44-page book *Nuestra casa en el universo* (Our Home in the Universe), an educational tool on climate change, and the Reducing Emissions from Deforestation and Forest Degradation proposal for indigenous communities in the Latin American tropics.	Public	Informal	http://www.stri.si.edu/nuestracasa/nuestra_casa.pdf
Ocean Month Annual Forum	STRI hosts an annual forum in celebration of Ocean Month. Climate change has been included in the program for this forum since 2005.	Public	Informal	https://www.stri.si.edu/english/education_fellowships/index.php
Public Outreach Program	STRI's public outreach program includes the "Smithsonian Talk of the Month" in Colón, Panamá. It provides STRI researchers and those from other academic institutions working at STRI an opportunity to share the results of their studies with the people from Colón. Prior to each presentation, STRI guides and volunteers go to four local radio stations to invite the community to attend the talk. In several of the monthly talks, researchers approach issues of climate change and its impact on countries such as Panamá, where the bulk of the population lives along the coast. These talks and other public outreach efforts stress that the Galeta Point Laboratory's instruments show rising sea levels, and it is essential to protect the local coastal and marine habitats, including coral reefs, seagrass beds, mangroves, wetlands, and lowland forests.	Public	Informal	https://www.stri.si.edu/english/education_fellowships/index.php

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Salamander Lab	Outreach for zoo visitors is conducted through the Salamander Lab, located at the Reptile Discovery Center, on research projects relating to climate change, specifically on the hellbender salamander and the Shenandoah salamander.	Public	Informal	http://nationalzoo.si.edu/ActivitiesAndEvents/Celebrations ambassadors.cfm
U.S. Department of Agriculture (USDA)				
Climate Change in the Southern Region	This Web site provides information on upcoming climate change seminars, climate-related reading materials, regional and agency climate initiatives, and tips for reducing one's carbon footprint. Leaders from various resource areas participate in regionwide climate change seminars, whose topics include region-specific information, adaptation, carbon, and planning.	Public	Formal/ informal	http://fsweb.r8.fs.fed.us/climate/index.php
Forest Service Research Web Site	This Web site provides online access to U.S. Forest Service (USFS) climate change research.	Public	Formal/ informal	http://www.fs.fed.us/research/climate/usfs-cc-research.shtml
Treesearch	This online search engine provides access to almost 30,000 USFS publications, including more than 4,500 climate change-related publications for the general public and land managers.	Public	Formal/ informal	http://www.treesearch.fs.fed.us
U.S. Department of Energy (DOE)				
Atmospheric Research Measurement (ARM) Climate Research Facility	Through DOE's Office of Science, ARM provides online materials to develop basic science awareness related to climate change and supports community outreach in ARM site regions.	Public	Formal/ informal	education.arm.gov
Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education	Intended to bolster energy literacy for all citizens, this document serves as a framework to teach energy using science, technology, and social science principles. Led by DOE, it was agreed to by 13 federal agencies, with significant public input.	K to gray	Online pamphlet; also, an alignment tool for educators to ensure all principles used	http://www1.eere.energy.gov/education/energy_literacy.html
National Training & Education Resource (NTER)	This DOE-created online, open-source training platform allows anyone to upload course materials or create content using state-of-the art tools to create immersive content.	All ages, but expected to be used for adults primarily	Online, open-source training platform	http://nterlearning.org
Solar Career Map	Explores a range of solar energy occupations, describing diverse jobs across the industry, charting possible progression between them, and identifying the high-quality training necessary to do them well.	Public	Career visualization online tool	http://www1.eere.energy.gov/solar/careermap/
U.S. Department of Transportation (DOT)				
University Transportation Centers Program	This program awards grants to universities across the United States to advance the state of the art in transportation research and to develop the next generation of transportation professionals.	Public	University	http://utc.dot.gov/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Transportation and Climate Change Clearinghouse	Designed as a one-stop source of information on transportation and climate change issues, this clearinghouse includes information on GHG inventories, analytic methods and tools, GHG reduction strategies, potential impacts of climate change on transportation infrastructure, and approaches for integrating climate change considerations into transportation decision making. The clearinghouse is funded jointly through the National Cooperative Highway Research Program and DOT's Center for Climate Change and Environmental Forecasting.	Public	Web site	http://www.climate.dot.gov
U.S. Environmental Protection Agency (EPA)				
Climate "Back to Basics" Informational Materials	Among the resources available on the Climate Change Web site and in print form is a series of "What You Can Do" fact sheets and Web pages that provide more than 25 easy steps to reduce GHG emissions and also increase energy efficiency and save resources. This information features actions that readers can take at home, at the office, on the road, and at school. A related science education resource for adults and students is the brochure "Frequently Asked Questions about Global Warming and Climate Change: Back to Basics," available in print and at http://epa.gov/climatechange/science/multimedia.html. The brochure addresses key questions asked by the public about this issue by restating in easy-to-understand language the most current climate science from widely accepted, peer-reviewed scientific literature.	Public	Formal/ informal	www.epa.gov/climatechange/wycd
EPA Climate Change and Health Effects on Older Adults Web Site	EPA's Aging Initiative has created a Web page that contains a fact sheet entitled "It's Too Darn Hot: Planning for Excessive Heat Events." The fact sheet has been widely disseminated throughout aging and public health networks. In an effort to reach people for whom English is not their first language, this fact sheet was translated into 15 languages. "Beat the Heat" posters highlighting key messages about steps to take during extreme heat are available in English and Spanish and have been shared in senior centers around the country.	Public	Formal/ informal	http://www.epa.gov/aging/resources/climatechange/index.htm
EPA Climate Change Web Site	Managed by EPA's Climate Change Division, the site is among the top results for "climate change" across search engines and averages more than 200,000 unique visitors a month. Updated in 2012, the site features information about climate change science, greenhouse gas (GHG) emissions and inventories, health and environmental impacts, adaptation activities and opportunities, EPA's varied activities on the issue, what individuals can do, frequent questions, and other educational resources.	Public	Formal/ informal	www.epa.gov/climatechange
EPA's Online Tools for Accessing Facility-Level Greenhouse Gas Data	EPA's Greenhouse Gas Reporting Program collects GHG data from large sources of GHG emissions and suppliers of products that release GHGs when released or combusted. EPA has developed easy-to-use online tools to share publicly available information gathered annually since 2010. The Facility-Level Information on GreenHouse gases Tool (FLIGHT) allows users to filter and view emissions data by facility, industry, location, or gas, and to create pie charts and other graphics based on custom searches. In the spring of 2013, FLIGHT will also be available as an application for mobile devices. The full set of nonconfidential GHG data collected through the program is also available through Envirofacts, EPA's one-stop-shop for environmental information.	Public	Formal/ informal	http://www.epa.gov/ghgreporting/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
General Audiences (K–12, Undergraduate, and Graduate Students; K–12 Teachers; Informal Educators; Professionals; Public				
National Aeronautics and Space Administration (NASA)				
Earth Climate Course: What Determines a Planet's Climate?	This set of student activities and teachers' guides connects NASA Earth science research with the teaching and learning of core science and mathematics concepts and skills, while addressing national education standards. The four modules cover (1) Temperature Variations and Habitability, (2) Modeling Hot and Cold Planets, (3) Using Mathematical Models to Investigate Planetary Habitability, and (4) How Atmospheres Affect Planetary Atmospheres. Scientific inquiry and research tools play a major role in the lessons. Presented with a science problem, students seek answers and consensus by experimenting with physical and computer models, collecting and analyzing their own measurements, and conducting comparisons with real-world data from satellites and ground-based observations.	K–12 students, K–12 teachers, undergraduate students	Formal	http://icp.giss.nasa.gov/education/modules/eccm/
Earth Observatory	Earth Observatory shares the images, stories, and discoveries about climate and the environment that emerge from NASA research, including NASA's satellite missions, in-the-field research, and climate models.	Public, K–12 students, K–12 teachers, informal educators	Informal	http://earthobservatory.nasa.gov/
Global Climate Change	This Web resource includes the planet's vital signs, feature stories, visualizations, and links to NASA missions involved in investigation of climate change. The interactive tool, Earth on the Earth 3D, provides near-real-time depiction of important climate variables from NASA Earth-observing satellites.	Public, K–12 students, K–12 teachers, informal educators	Informal	http://climate.nasa.gov/
MyNASAData	Working to make NASA Earth science data accessible to the K–12 and citizen scientist communities, the project's principal activity is to create "microsets" from large scientific data sets, and to wrap these with tools, lesson plans, and supporting documentation so that teachers can use the information in the classroom. Climate change-related lesson plans are available for middle and high schools.	K–12 teachers, K–12 students, citizen scientists	Formal/informal	http://mynasadata.larc.nasa.gov/
NASA Minority University Research and Education Innovations in Climate Education (NICE)	NICE was created in fiscal year (FY) 2011 to extend the results of NASA's Earth Science Program to the education community by sponsoring unique and stimulating opportunities for global climate and Earth system science education at minority-serving institutions. NICE is designed to improve the quality of the nation's STEM education and enhance faculty, student, and teacher access to NASA-unique content related to global climate and Earth system change. In FY 2013, NICE is focusing on tribal colleges and universities. Partners: NSF, NOAA, ICE-t green team	K–12 teachers, undergraduate students	Formal/informal	http://www.nasa.gov/offices/education/programs/descriptions/NASA_Innovations_in_Climate_Education.html
National Oceanic and Atmospheric Administration (NOAA)				
Climate.gov	This source of timely and authoritative scientific data and information about climate works to promote public understanding of climate science and climate-related events, to make its data products and services easy to access and use, to provide climate-related support to the private sector and the nation's economy, and to serve people making climate-related decisions with tools and resources that help them answer specific questions.	Public, professionals, K–12 teachers, informal educators, graduate students, undergraduate students, K–12 students	Informal	http://www.climate.gov/

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
National Science Foundation (NSF)				
Antarctic Integrated System Science (AISS)	The discoveries of disciplinary science increasingly highlight the need for integrative approaches to forge new understanding of the complex interactions that govern Antarctica and its past, present, and future roles in the Earth system. AISS was established to respond to this need and foster progress on some of the most pressing issues on a planet subject to potentially accelerated change. AISS administers projects that transcend disciplinary boundaries, are highly integrated, and address questions broader in scope than those typically supported by the disciplinary programs described above.	Undergraduate students, graduate students, K–12 teachers, professionals, public	Formal, informal	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503240
Arctic Research and Education Program	This program supports activities that bridge research and education in concert with funded research grants and agreements through supplement requests or as separate proposal requests to support new ventures. Arctic research spans the major STEM fields and is often multi- or interdisciplinary. Research in the Arctic has clear applications for education and outreach at many levels. The region itself is an interesting hook for teaching about life, physical, and social sciences, and such concepts as ocean and atmosphere circulation, climate, Earth system science, animal migrations, and life in extreme environments.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K-12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13448
Arctic Research Opportunities	The goal of NSF's Arctic Sciences Section is to gain a better understanding of the Arctic's physical, biological, geological, chemical, social, and cultural processes; the interactions of oceanic, terrestrial, atmospheric, biological, social, cultural, and economic systems; and the connections that define the Arctic. This umbrella solicitation provides detailed information on research opportunities to be supported by the Arctic Natural Sciences, Arctic System Science, Arctic Social Sciences, Arctic Observing Network, and Advanced Cyberinfrastructure programs.	Undergraduate students, graduate students, K–12 teachers, professionals, public	Formal, informal	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5521
Climate Change Education Partnership (CCEP)	CCEP seeks to establish a coordinated national network of regionally or thematically based partnerships devoted to increasing the adoption of effective, high-quality educational programs and resources related to the science of climate change and its impacts. Each CCEP is required to be of a large enough scale that it will have catalytic or transformative impacts that cannot be achieved through other core NSF program awards.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503477
Coastal SEES	Coastal SEES (Science, Engineering and Education for Sustainability) is focused on the sustainability of coastal systems. For this solicitation, NSF defines coastal systems as the swath of land closely connected to the sea, including barrier islands, wetlands, mudflats, beaches, estuaries, cities, towns, recreational areas, and maritime facilities; the continental seas and shelves; and the overlying atmosphere. These systems are subject to complex and dynamic interactions among natural and human-driven processes.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504816
Cyber-Enabled Sustainability Science and Engineering (CyberSEES)	CyberSEES's goal is to advance interdisciplinary research in which the science and engineering of sustainability are enabled by advances in computing, and where computational innovation is grounded in the context of sustainability problems.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504829

Table 9-1 (Continued) **Federal Climate Change Programs Grouped by Primary Audience**

Program Name	Description	Audiences	Learning Setting	Web Site
Dynamics of Coupled Natural and Human Systems (CNH)	The CNH competition promotes quantitative, interdisciplinary analyses of relevant human and natural system processes and complex interactions among human and natural systems at diverse scales.	Undergraduate students, graduate students, K-12 teachers	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13681
Long-Term Ecological Research (LTER)	Research at LTER sites provides experiments, databases, and research programs for use by other scientists. It must test important ecological or ecosystem theories, including ecosystem stability, biodiversity, community structure, and energy flow. LTER currently supports 26 active sites representing major biotic regions of the continental U.S. and Alaska, the marine environment, and the Antarctic continent. Its disciplinary scope includes population and community ecology, ecosystem science, evolutionary biology, phylogenetic systematics, social and economic sciences, urban ecology, oceanography, mathematics, computer science, and science education.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=7671
Ocean Acidification	The need for understanding the potential adverse impacts of a slowly acidifying sea upon marine ecosystems is widely recognized and included as a priority objective in the new National Ocean Policy. The effects of ocean acidification could significantly affect strategies for developing practices enhancing the sustainability of ocean resources. This program supports basic research concerning the nature, extent, and impact of ocean acidification on oceanic environments in the past, present, and future.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	
Sustainability Research Networks (SRNs)	SRNs will engage and explore fundamental theoretical issues and empirical questions in sustainability science, engineering, and education that will increase understanding of the ultimate sustainability challenge—maintaining and improving the quality of life for the nation within a healthy Earth system. SRNs will link scientists, engineers, and educators, at existing institutions, centers, and networks, and will also develop new research efforts and collaborations.	Undergraduate students, graduate students, K–12 teachers, professionals	Formal (K–12, undergrad, grad)	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503645
U.S. Department of Energy (DOE)				
Collegiate Wind Competition	This competition is designed to strengthen the future wind workforce by connecting industry to young innovators and inspiring career choices in wind energy. The competition is a forum for college students from multiple disciplines to investigate innovative wind energy concepts; gain experience designing, building, and testing a wind turbine to perform according to a customized market data-derived business plan; and increase their knowledge of wind industry barriers.	Undergraduate students and faculty; professionals in the wind industry	Competition event	http://www.windpoweringamerica.gov/filter_detail.asp?itemid=3777
Student & Educator Resources Web Page	Provides age-appropriate educational resources for K–12 and higher-education students looking to learn more about the biomass field, a list of biomass-related academic institutions for students interested in pursuing higher education in the field, and resources for educators teaching bioenergy-related lessons at the K–12 level.	K–12 students, undergraduate and graduate students, educators	Web site	http://www1.eere.energy.gov/biomass/for_students.html
Wind for Schools	This program installs small wind turbines at rural elementary and secondary schools and develops Wind Application Centers at higher-education institutions. Wind Application Centers provide technical assistance in all aspects of wind energy to rural schools and communities.	K–12 students and teachers; undergraduate students and faculty; general public	Classroom; on-site training; Web site; software	http://www.windpoweringamerica.gov/schools/projects.asp